



TECHNICAL SPECIFICATIONS
for
Palo Pinto Mountains State Park
Set 01: Site Development

TPWD Project No. 118271

100 Percent Construction Documents, 29 March 2021

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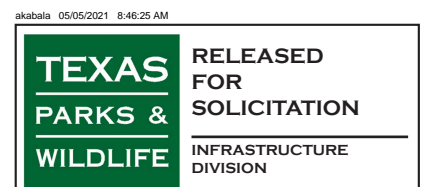
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00 01 07 - DESIGN PROFESSIONAL SEALS PAGE

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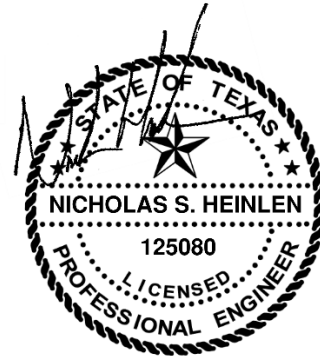
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END OF DOCUMENT 00 01 07

DOCUMENT 00 01 00 - TABLE OF CONTENTS

DIVISION 00 - INTRODUCTORY INFORMATION

- 00 01 01 Project Title Page
- 00 01 07 Design Professionals Seals Page
- 00 01 10 Table of Contents

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

Documents Provided by TPWD

- 00 31 09 Sustainability Plan
- 00 31 32 Geotechnical Data
- 00 31 32.16 Material Testing Information

DIVISION 01 - GENERAL REQUIREMENTS

Sections Provided by TPWD

- 01 74 19 Construction Waste Management and Disposal BBP

DIVISION 02 - EXISTING CONDITIONS

- 02 41 13 Selective Site Demolition SO

DIVISION 03 - CONCRETE

- 03 20 00 Concrete Reinforcing DA
- 03 30 00 Cast-In-Place Concrete DA
- 03 30 53 Landscape Cast-In-Place Concrete SO

DIVISION 04 - MASONRY

- 04 05 11 Landscape Masonry Mortaring SO
- 04 05 14 Landscape Masonry Grouting SO
- 04 22 00 Landscape Concrete Unit Masonry SO
- 04 42 00 Landscape Stone Assemblies SO
- 04 44 00 Collected Stone SO

DIVISION 05 - METALS

- 05 12 00 Structural Steel Framing DA
- 05 50 05 Landscape Metal Fabrications SO
- 05 52 05 Landscape Metal Railings SO

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

- 06 15 00 Wood Decking SO

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

- 07 92 05 Landscape Joint Sealers SO

DIVISION 26 - ELECTRICAL

- 26 05 00 Basic Electrical Materials and Methods JJA
- 26 05 20 Conductors and Cables JJA
- 26 05 30 Raceways and Boxes for Electrical Systems JJA
- 26 05 60 Grounding and Bonding for Electrical Systems JJA

26 05 75	Identification for Electrical Systems	JJA
26 95 10	Electrical Cleaning and Testing	JJA

DIVISION 31 - EARTHWORK

31 22 16	Fine Grading	S0
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DIVISION 32 - EXTERIOR IMPROVEMENTS

32 13 13	Landscape Concrete Paving	S0
32 14 40	Stone Paving	S0
32 15 00	Aggregate Surfacing	S0
32 31 11	Swing Gate Operators	S0
32 33 00	Site Furnishings	S0
32 91 19.16	Topsoil	S0
32 92 00	Turf and Grasses - Organic	S0
32 93 00	Planting - Organic	S0
32 93 96	Tree Salvaging	S0
32 95 00	Planting Maintenance - Organic	S0

END OF DOCUMENT 00 01 00

DOCUMENT 003109 – SUSTAINABILITY PLAN

1.1 SUSTAINABILITY PLAN

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but do not affect Contract Time requirements. This Document and its attachments are not part of the Contract Documents.
- B. Available Project information includes the following:
 - 1. Texas Parks and Wildlife Department (TPWD) 2020 Sustainability Plan.
 - 2. TPWD Sustainable Design Checklist.
- C. Project sustainability plan including design and construction milestones is available for viewing as appended to this Document.

END OF DOCUMENT 00 31 09



Texas Parks and Wildlife Department

2020 Sustainability Plan

TPWD Agency Mission

To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

TPWD Sustainability Program Mission

To manage and conserve the resources of the Texas Parks and Wildlife Department through recycling and waste reduction efforts, energy efficiency investments, and water conservation practices in order to protect and preserve natural resources and to set an example as a resource agency.

Introduction

Texas Parks and Wildlife Department (TPWD) is a conservation agency, therefore resource conservation holds significant importance in all that we do, from our agency mission to our Land and Water Resource Conservation and Recreation Plan. Furthermore, TPWD Executive Director, Carter Smith, and other leaders within the department have established sustainability as an agency priority. Texas State Parks Division leaders have also shown the importance of sustainability to staff by encouraging a Regional Green Team, discussing the topic at their state-wide conference, and establishing a category for sustainability in their employee recognition award program. TPWD leaders recognize that environmental sustainability has an impact on both the fiscal budget as well as the public's perception of our agency. As a conservation agency we must be frontrunners in the area of sustainability, encouraging our visitors and constituents to follow our lead in their own homes and in their day to day lives.

"What is Sustainability? Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations."¹

¹ <http://www.epa.gov/sustainability/basicinfo.htm#sustainability>

Sustainability considers our use of resources so that we will continue to have the water, materials, and resources needed to maintain human and environmental health.

The 2020 Sustainability Plan focuses primarily on actions that can be taken in the next 5 years. However, the commitment to conservation is ongoing effort that will continue to require thought, input, and dedicated action well into the future. While much of the plan may remain relevant over the years, this plan will require periodic re-evaluation and updates. As programs and solutions are developed to deal with current obstacles new obstacles may arise. These issues that have not yet been identified need to be addressed through a new or updated plan. This will be an ongoing process requiring regular evaluation of where we are as a conservation agency and how we plan to grow in our sustainability efforts.

Within this plan there are broad, agency level goals that require participation of all divisions to be successful. They will provide structure and guidance toward achievement of our agency sustainability goals. In addition to the overarching agency goals, there will be divisional action items developed, managed, and tracked by each division. These actions will support the broader agency-level goals by identifying more focused, specific action items. Some examples of divisional level sustainability goals may be found in the **Appendices** of this document.

Each division will assign a Point of Contact (POC) to represent their Division on the TPWD Sustainability Committee. These team members will work to share information about how their division is working to carry out the sustainability action items that they have developed. Additionally, they will voice concerns, discuss obstacles, and share success stories to help advance ongoing work. The Sustainability Committee representative will provide bi-annual updates to the Executive Office about how each division is meeting their self-prescribed sustainability action items and how those are helping meet the goals set forth in this plan.

Background

Through an examination of the past efforts that have been taken toward achieving sustainability within Texas Parks & Wildlife, we can begin to develop achievable and targeted goals for our future. The agency developed a facilities specialist position in 2009 to manage energy usage reporting and management. That position has grown to encompass leadership of the TPWD Green Team and targeted sustainability projects. There is a wide opportunity for growth as the agency enhances its efforts in recycling, energy efficiency, and water conservation.

As we develop future plans and measurable sustainability goals, we continue to review what has worked in the past and what measures are currently in place, working to capitalize on our prior successes and learning from our less successful ventures.

Sustainability is a Strategic Part of the Land and Water Resources Conservation and Recreation Plan

“The Land and Water Resources Conservation and Recreation Plan (known as the Land and Water Plan, or “the Plan”) serves as the strategic visionary document guiding the TPWD in achieving its mission to conserve land and water resources and to provide outdoor recreation opportunities for all Texans.” This guiding document for TPWD provides supporting documentation as to why sustainability is an agency priority.

“As our population grows, so will the impacts and pressures on our lands and waters. The growing number of Texans seeking outdoor experiences will call for new recreational opportunities. Emerging energy technologies will require us to balance new energy sources with their potential impacts on wildlife habitat. Conserving adequate water for healthy communities, economies, and our environment will be of paramount importance in the years to come. As we tackle these many challenges, we will continue to utilize the best available science-based research and staff expertise and will rely on the input of state leaders and our public and private partners.”²

“Texas Parks and Wildlife Department manages over 770,000 acres of wildlife management areas and 600,000 acres of state parks, natural areas and state historic sites. With 12 distinct ecoregions covering approximately 268,500 square miles, Texas has an astounding array of climates, soils and habitats. High plains, wetlands, mountains, deserts, forests and coastal marshes provide habitat for the fish and wildlife resources that help define the landscape.”³ As an agency we are responsible for an expansive amount of public lands. This plan will help TPWD sustainably manage our state’s natural resources and provide an example to all Texans, which directly supports the vision of the TPWD Land & Water Plan.

Overarching Plan Goals

Just as the Land and Water Plan provides strategic vision for TPWD, the Sustainability Plan offers strategic vision for the agency in how it can increase and advance resource conservation efforts. Additionally, the agency mission is supported by the mission of the TPWD sustainability program, offering a more detailed focus on how we can conserve the natural resources of Texas. Sustainability for TPWD can be addressed in three major categories: Energy Efficiency, Water Conservation, and Waste/Recycling.

² Letter to the People of Texas

https://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_pl_e0100_0687_2013.pdf

³ https://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_pl_e0100_0687_2013.pdf (p. 4)

Energy efficiency is one of the easiest and most cost effective ways to reduce operational costs for our facilities and has the added benefit of combating climate change. It is the backbone of sustainable building and makes smart business sense as it provides a quick return on the initial investment in most cases through energy savings. Systemic issues result from TPWD's continued use of outdated, inefficient equipment, which is due to a short-term, needs focus on initial costs rather than seeking long-term savings and benefits of investment in efficient equipment. It is in TPWD's best interest to address this issue and take action as soon as possible to remedy the situation. While much of the opportunity for energy efficiency comes from smart choices in building construction and renovation, there are many opportunities for divisions outside of Infrastructure to modify behavior through purchasing practices, transportation, and operations that will positively impact energy use. Each division will be able to best identify areas for energy savings within their own daily operations.

Water conservation is especially important to TPWD because the lack of water resources has a severe and direct impact on agency operations. In addition to traditional water services for visitors including drinking water and bathing facilities, TPWD uses water for irrigation, wetland enhancement, and fish hatcheries. Severe drought has led to low water tables and devastating wildfires which have resulted in site closures across TPWD divisions impacting Wildlife Management Areas, State Parks, and even Fish Hatcheries. The State of Texas is facing exceptional or extreme drought resulting in prolonged, dry conditions that put a strain on water supplies. TPWD must educate its visitors and lead by example in water conservation to help alleviate the negative impacts of drought. Water conservation practices and conservation messaging can be integrated into many areas of TPWD work. Again, each division and program will be able to best identify opportunities for water conservation.

Finally, **waste mitigation and recycling** are areas ripe for improvement at TPWD. As recycling programs in urban areas have become well established, rural areas (where many of our facilities are located) are just beginning to offer recycling programs. As a result, many TPWD facilities in those areas have struggled to implement recycling programs, typically citing cost as the major obstacle. TPWD operates in a vast range of areas and each one presents unique challenges and solutions to the waste and recycling issue. Recognizing that one solution will not fit all, each division will set their own actions toward meeting TPWD waste reduction efforts.

Although these categories of sustainability are discussed in separate sections of this document, it is important to acknowledge that they are interconnected. Conserving water for instance also saves the energy needed to clean and pump water for distribution. Recycling uses less energy to generate base materials for new products than processing virgin resources. Processing virgin materials is also often water intensive and recycling materials uses less water to produce the same end product. Like our environment, conservation of resources is inter-connected and small efforts to conserve can make a rippling impact.

Energy

Background:

Texas Parks and Wildlife Department spends nearly \$5 Million dollars annually on electric utilities. Energy prices are at a historic low today but market changes and new regulations have created projections that utility rates will increase rapidly over the next decade. This means that TPWD could double or even triple the amount of public dollars spent in operation of its facilities. The cost of postponing energy efficiency upgrades will rise as we delay investment. In addition, many TPWD buildings were built in the 1980's or earlier. They require attention and investment to be brought up to today's efficiency standards.

Investments in more efficient equipment are often delayed because they may cost more initially compared to less efficient alternatives. Inefficient equipment may be used because it continues to function, even when the new efficient equipment will pay for itself through energy savings and may provide a more comfortable environment. One example is the continued use of inefficient T-12 fluorescent tube lighting throughout TPWD facilities when more efficient upgrades have a return on investment of 3 years or less.

Overall savings from more efficient equipment is realized as the apparatus continues to operate over time. It is worth noting that savings are typically achieved within operational budgets, separate from construction or repair budgets which normally fund these upgrade projects. This would impact how the return on investment in energy saving equipment is considered and may require a shift in agency accounting.

Every work group within TPWD makes daily decisions about how they will use energy. Choices may include whether to purchase EnergyStar rated or energy efficient equipment, what vehicles are purchased and how they are driven, or when to power down equipment. Simply turning things off when they aren't being used can have a significant impact on energy consumption. Everyone can play a part in helping to conserve energy.

TPWD must make investment in energy efficiency a priority both for cost savings and to reduce environmental impact. Power plants and natural gas use are currently responsible for about 50% of greenhouse gas emissions, which contribute to the risks of global climate change.⁴ Power plants are also a major contributor to the amount of mercury found in waterways. This leads to increased levels of mercury in fish populations. Energy efficiency and energy conservation will have a direct and positive impact on TPWD.

⁴ http://www.epa.gov/cleanenergy/documents/suca/consumer_fact_sheet.pdf

Goals:

- By 2020, reduce TPWD net consumption of electric energy and natural gas by 10% from 2010 levels through investment in energy efficient equipment and through behavioral changes.
- By 2020 install or acquire over 1MW of solar photovoltaics used by TPWD facilities
- By 2020 track the energy use of all applicable facilities⁵ through the EnergyStar Portfolio Manager⁶
- By 2020 each division will develop and implement an educational based plan to educate staff and/or constituents about energy conservation and/or efficiency.
- By 2020 convert 75% of all vehicles to alternative fuel or low-emission vehicles.

Several opportunities for targeted or specific action are identified in **Appendix A** of this document. They serve as a guide for divisions as they develop their own goals and actions for energy use reduction. Many of these actions seek to set sustainable building standards in construction. Although establishment of building standards is mainly Infrastructure related, each division may find these helpful in developing directly applicable actions. These will help TPWD take a step toward additional sustainable construction and more sustainable operation of those facilities.

Finance Plan:

Typically, funding for operating budgets and construction is provided through general fund appropriations provided by the Texas Legislature. However, there are several alternative financing options worthy of consideration when the proposed project will yield energy savings. There is good reason for considering these alternatives when traditional funding sources are not available. Many times energy efficiency projects will pay for themselves in energy savings long before traditional funding sources can be allocated. Moving forward on energy efficiency projects not only helps TPWD conserve resources, it helps TPWD reduce operation costs thereby saving money during the operational life of the equipment. The following are a few financing options to consider in energy efficient upgrade projects.

⁵ The EnergyStar portfolio manager sets parameters, such as size and building use, for the types of buildings that may be analyzed.

⁶ <http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager?s=mega>

Return on Investment (ROI) - Set a minimum payback or standard for selecting or rejecting an energy efficiency project. For instance, if a project will result in a simple ROI of less than 3 years, that project receives the green light to move forward using dedicated agency resources.

Dedicated Agency Resources – Create a project funding source to move projects forward that have a quick return on investment. Establish a sustainable funding source to replenish this fund by requiring projects to contribute a portion of their energy savings. Set policies that direct a portion of funding received from grants, incentives, and energy savings toward future efficiency projects.

Incentives -TPWD has properties that operate in both regulated and de-regulated utility areas. Incentives may be available in both areas but primarily in de-regulated areas.

LoanStar Loans - The Texas LoanSTAR (Saving Taxes and Resources) revolving loan program finances energy-related cost-reduction retrofits for state, public school district, public college, public university, and tax-district supported public hospital facilities.⁷ Low interest rate loans are provided to assist borrowers in financing their energy-related cost-reduction efforts. Applicants repay the loans through the stream of energy cost savings realized from the projects.

⁷ 10 Tex. Gov. Code §2305.032 <http://www.statutes.legis.state.tx.us/Docs/GV/htm/GV.2305.htm>

Water

Background:

Large sections of the state are experiencing exceptional or extreme drought. These prolonged, dry conditions put a strain on water supplies for all uses. An extensive study conducted by the Texas A&M Forest Service estimated that 301 million rural trees were killed by the 2011 Texas drought⁸. This is just one example of the overwhelming impact drought has had on Texas. Drought impacts TPWD negatively in a number of ways including reduction in visitation which results in a reduction of fees collected. It can impact conservation practices such as wetland enhancement and fish breeding. Drought also leads to extreme fire hazards which can have devastating results like the Bastrop or Possum Kingdom Wildfires leading to a dramatic impact on the natural resources, wildlife, and TPWD finances.

Even if the current extreme drought conditions were not diminishing Texas water supplies, the rapidly growing population in Texas is enough to seriously threaten the availability of water resources. The Texas Data Center and the Office of the State Demographer project that the state's population will increase by 71.5 percent between 2000 and 2040, from 20.9 million to 35.8 million.⁹ Across the state, as populations grow, water resources will be stretched further and be in higher demand. TPWD has an opportunity to do a better job of conserving water at our facilities and educating visitors about the importance of water conservation for the benefit of current and future Texans.

Goals:

- By 2020, establish an agency policy to only install fixtures with the WaterSense¹⁰ label and retrofit 50% of existing water fixtures with WaterSense¹¹ labeled products.
- By 2020, install 10 rainwater catchment systems in public areas for educational and landscaping or wildlife use.
- By 2020 each division will develop and implement an educational based plan to educate staff and/or constituents about water conservation and/or drought issues.

There is a fantastic opportunity to save water through efficient fixtures while simultaneously modeling efficient water use for our visitors. Through education and leading by example TPWD

⁸ <http://texasforestservice.tamu.edu/main/popup.aspx?id=16509>

⁹ <http://www.window.state.tx.us/specialrpt/tif/population.html>

¹⁰ http://www.epa.gov/watersense/about_us/watersense_label.html

¹¹ http://www.epa.gov/watersense/about_us/watersense_label.html

will be able to reduce water waste across the state, benefiting both humans and wildlife. Through the fulfilment of these goals and beginning the relatively inexpensive investment in efficient fixtures, TPWD can be a state leader in water conservation. A few specific actions that could be taken to advance water conservation efforts at TPWD have been identified in **Appendix B** of this document. These may serve as a resource for divisions as they develop their own goals and actions for water conservation.

TPWD obtains water from a variety of non-traditional, municipal sources. Most of these sources such as water right permits, groundwater, well water, and contracted supplied water are not metered or captured in current utility management systems. In order to manage what we consume we must measure it. Although metering and documenting usage from these non-traditional sources may be difficult, it will help TPWD identify how much water is being consumed. This will help the agency identify changes in consumption or compare usage which could lead to the identification of conservation opportunities and improved management of the resource.

Finance Plan:

Some funding may be available to help assist with agency water conservation efforts. Many municipal water providers are adopting conservation programs and offer incentives and rebates as part of that initiative. Additionally, both federal and state government entities recognize the impact of drought and have allocated funding to provide assistance in water resource conservation as well as in provision of educational messages. TPWD is an excellent candidate to utilize and leverage these opportunities and the agency should explore these prospects.

Incentives - Incentives may be available from local water companies to install water conserving fixtures

Grants - The US Department of the Interior, Texas Water Development Board, and State of Texas have offered various grants in the past to assist state agencies improve water efficiency standards. These resources are likely to be available again in the future as a potential funding source.

Waste & Recycling

Background:

TPWD does not have an established agency recycling or waste policy. Although some sites (e.g. Austin HQ and Seminole Canyon SP) have comprehensive recycling programs, there are many offices and remote park locations that do not recycle anything. As recycling programs in more populated, urban areas expand and gain popularity the recycling opportunities in rural communities are beginning to be established. TPWD state park visitors expect to recycle when they visit a facility; therefore, TPWD can play a strategic role in building the momentum needed to expand recycling opportunities in many rural areas. We can also learn from the success that other agencies have had with developing recycling programs in remote areas.

The National Parks Service has established a strong waste diversion program and currently offers recycling in every national park. The Department of the Interior (DOI) has set the current diversion rate goal at 50% per year by 2010 (Note: This goal is likely to be revised by DOI in the near future; states may have higher recycling goals). This means that 50% of all solid waste materials generated by National Parks should be diverted from disposal at a landfill through reuse, recycling, composting, or energy recovery programs.¹²

Goals:

- By 2020, establish waste diversion programs (including recycling of plastic and aluminum) in at least 50% of its facilities statewide.
- By 2020, collect and report diversion rates at all TPWD facilities annually.
- Develop partnerships with community organizations that are also working toward waste diversion, including Keep Texas Beautiful and its affiliates¹³ to leverage recycling opportunities in small or rural towns.
- By 2020 each division will develop and implement an educational based plan to educate staff and/or constituents about waste mitigation and recycling.

TPWD facility recycling can be achieved in a variety of ways, although one method of implementation will not meet the needs of every site. Partnerships with community organizations that share a similar mission of waste diversion in their community, such as Keep

¹² http://www.doi.gov/greening/waste/upload/SW_Ref_Guide_final.pdf

¹³ <http://www.ktb.org/about-us/affiliate-network.aspx>

Texas Beautiful affiliates, local municipal waste and recycling departments, and local area Councils of Government can be excellent resources to help facilities overcome recycling roadblocks. Hauling fees can often be the largest roadblock to initiating recycling programs in rural or remote areas. Aggregating materials through community partnerships may help to reduce cost-prohibitive hauling fees. Additionally, partnering with other governmental entities may offer opportunities to deposit recyclables at a more central location, saving additional hauling fees. The attached **Appendix C** includes some specific waste & recycling actions that can be taken to initiate a successful waste reduction program. These may serve as a resource for divisions as they develop their own goals and actions for waste diversion and recycling programs.

Finance Plan:

Although, the cost of establishing recycling programs and other waste diversion programs in a rural area can be prohibitive, which is currently the most cited reason sites provide for lack of participation, many times there are opportunities to offset these costs. For example, hauling charges are one of the main reasons for high costs. Cost-saving efforts are being made among rural communities to aggregate materials for hauling. TPWD could leverage partnerships with local cities, counties, Keep Texas Beautiful affiliates, and other non-profit organizations to increase and expand recycling and waste diversion opportunities within our TPWD facilities and surrounding communities. Through these partnerships, tipping fees to dump recyclables may be waived. Additionally, assistive funds may be available through the Texas Commission on Environmental Quality or the Local Council of Governments.

Summary

Texas Parks and Wildlife Department has an opportunity and a responsibility to lead Texas toward a more sustainable future. Adopting the goals set forth in this plan and establishing sustainability as an agency priority is an integral part of meeting the TPWD mission to protect and preserve the natural resources of Texas for present and future generations. Each TPWD employee has a part to play regardless of the division they work within or the job they do and each individual can make an impact. Although it will require time, effort and resources to implement this plan the result will be a more resilient and effective agency that will be prepared to face the environmental challenges ahead.

Appendix A

Example Sustainable Building Actions Items:

1. Adopt high efficiency building standards and specify energy efficient equipment for all new construction. Require a written statement from the site Superintendent or Manager when less efficient alternatives are used.
2. Upgrade or retrofit existing facilities with high-efficient alternatives
3. Encourage energy saving behavior from staff and site users
4. Invest in renewable energy alternatives
5. Specify light-colored or reflective roofing materials
6. Install conduit lines to make building "PV ready"
7. Orient all structures to maximize solar heat gain in winter and minimize heat gain in summer.
8. Utilize natural ventilation and lighting to minimize energy use impacts.
9. Extend building overhang when windows are south facing to minimize solar heat gain in the summer months.
10. Procure appliances that carry the EnergyStar label when available.
11. Use high efficiency HVAC units, minimum 13 SEER.
12. Provide electrical outlet in new parking areas for electric vehicle charging when appropriate and when electrical service is available at the site
13. Use variable speed drive motors when applicable to improve energy efficiency
14. Require 50% of all wood products used in construction to have Forest Stewardship Council certification.

Example Lighting Action Items:

1. Specify outdoor lighting options at 3100K correlated color temperature (CCT) or lower to minimize the impact on most wildlife.
2. Use LED (Light Emitting Diode) lamps for all new and retrofit lighting applications.
3. Install occupancy sensors or timers in all indoor locations
4. Install photocell sensors or timers in all outdoor locations
5. Specify indoor lighting to be at or less than 4100k correlated color temperature (CCT)
6. Eliminate or upgrade T-12 Lighting at all TPWD Facilities and consider replacement of fixtures along with the lighting upgrades in most cases
7. Prepare for the GEXA electric energy contract rate of \$0.07 kWh to rise after January 1, 2016
8. Remove ballasts in all T12 fixtures and dispose of properly
9. Prepare for limited availability of T12 lamps and ballasts because they are no longer in commercial production.
10. Consider LED lamps in retrofit cases. Although they are slightly more expensive than T8, Super T8 or T5 options, they use less energy and yield a longer life.
11. Consider TPWDs history of implementing lighting upgrades when deciding where and what products to use when making lighting investments. Lighting equipment installed in TPWD

facilities will likely not be upgraded for at least 10 years. Past upgrades have been delayed as long as 30+ years.

12. Fully shield new outdoor fixtures and retrofit existing fixtures when possible, at all TPWD facilities to meet International Dark Sky Park recommendations to help minimize artificial lighting impacts on nocturnal plants and animals.

Example Energy Considerations / Assumptions

1. Incentives may be available for combined projects in specific areas (~20% project cost)
2. Simple paybacks between 5-20 years depending on initial cost, energy savings, and energy costs rising over time.
3. Fixtures are likely to remain installed for 25+ years so choose wisely and for the long-term.
4. Lighting change outs may be performed in a one-by-one replacement through existing park or facility maintenance staff but this is too much of a burden to require existing staff to install a full site lighting upgrade.
5. Contracted upgrades provide an equipment warranty, maintenance warranty, certified installers, incentive opportunities, quick installation, proper disposal, and bulk product discount.
6. Occupancy sensors and lighting controls are a good add-on to earn more efficiency and energy cost savings.
7. Electrical panel upgrades and other upgrades may be necessary in some cases to bring the facility up to code.
8. 2010 Energy Consumption Levels:

50,730,786 kWh	\$ 6,541,220 Total Electric Cost
<u>124,909 Therms</u>	<u>\$ 108,464 Total Natural Gas Cost</u>
185,584.2 Total MBTU	\$ 6,649,684 Total Energy Cost
9. 2014 Estimated Renewable Solar Energy Investments: 750 kW

Appendix B

Example Water Action Items:

1. All plumbing fixtures must carry the WaterSense label (toilets, showerheads, faucets)
2. Require the use of only native plants as part of site landscaping
3. No irrigation may be used after establishment of landscaping (typically 3-6 months)
4. Direct gutters to collect rainwater and install a rainwater collection source (may be used for landscape irrigation, gray water reuse, etc.)
5. Develop, submit and implement a Storm Water Pollution Prevention Plan (SWP3) for facilities with a site impact of 1000 sq. ft or larger. Include mitigation plan for parking lot storm water runoff.
6. Preserve existing native vegetation when possible paying particular attention to the preservation of established native trees and understory.
7. Install low-flow fixtures at all camp-loop water spigots and include information about water conservation at all public restroom facilities.
8. Retrofit all existing water fixtures with WaterSense labeled products.

Appendix C

Waste and Recycling Actions:

1. Develop, submit, and implement a construction waste management plan. Recycle or reuse materials when possible.
2. Provide education and interpretation resources to visiting public at sites with waste diversion programs
3. Develop relationships with community partners to minimize waste and expand recycling programs.
4. Set a policy to select environmentally preferable products or products with recycled content, especially when purchasing office supplies
5. Set a recycling policy and requirement for all new construction and building renovation
6. Consider the installation of water-bottle filling stations to encourage bottle re-use and to reduce the amount of plastic water bottles used in park facilities.

**Exhibit 3
For Task Order Proposal**

TPWD Sustainable Design Checklist

This list identifies resource conservation strategies that meet the goals of the 2020 Sustainability Plan. They shall be considered for all construction projects at scope validation.

The checked items have been identified by the Project Team for implementation on this project.

Site Resource Conservation	✓	Preserve Floodplain Functions	Energy Conservation	✓	EnergyStar Appliances
	✓	No/Limited Wetland Development		✓	Building Envelope (Exceed IECC Codes)
	✓	Storm Water Pollution Prevention Plan		✓	LED Lighting
	✓	Native Vegetation/Landscaping		✓	Conduit for Solar-Ready Building
	✓	Reuse soil/rock materials generated onsite		✓	Renewable Solar Energy
	✓	Passive Orientation Strategies		✓	Solar Hot Water
	✓	Dark Sky Lighting / Reduce Light Pollution		✓	Building Controls / Advanced Metering
	✓	Reduce Heat Island Impact		✓	High Efficiency Mechanical Equipment
	✓	Alternative Transportation Measures		✓	Net-Zero Building
	✓	Restore Disturbed Soils		✓	Daylighting
	✓	Limit Development/ INF Footprint	Material Resource Conservation	✓	Regional Materials (min 50%)
	✓	Storm Water Features (ex: bioswales)		✓	Recycled Content (min 20%)
	✓	Surface/Groundwater Contamination		✓	FSC Certified Wood Products
	✓	No/Limited Impact on Threatened or Endangered Species Habitat		✓	Low VOC Emitting Materials
Water Resource Conservation	✓	No Irrigation (after established, 1yr max)		✓	Construction Waste Management Plan
	✓	Drip Irrigation System		✓	Recycling Station
	✓	Gray-water Reuse		✓	Material Reuse/Salvage (min 20%)
	✓	Double Plumbed		✓	Zero CFCs
	✓	Rainwater Catchment		✓	Resiliency
	✓	Low-flow Fixtures		✓	Operation and Maintenance
	✓	Meter Water Use	Other	✓	Aesthetics; "Life's Better Outside"
				✓	Educational / Community Engagement

DOCUMENT 00 31 32 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. A geotechnical investigation report for Project, prepared by Terracon Consultants, Inc., dated 17 August 2020, is appended to this Document.
 - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

END OF DOCUMENT 00 31 32

DRAFT

Terracon

GEOTECHNICAL ENGINEERING MEMORANDUM PALO PINTO MOUNTAINS STATE PARK STRAWN, PALO PINTO COUNTY, TEXAS

TO: Mr. Greg Thelen, P.E. **DATE:** August 17, 2020
FROM: Siva P. Pathivada, P.E. and Ali Q. Abdullah, P.E. **PROJECT NO.:** 94175276

SUBJECT: PRELIMINARY FOUNDATIONS RECOMMENDATIONS

1.0 INTRODUCTION

This memorandum provides preliminary geotechnical design recommendations based on the encountered subsurface conditions and testing results from the boring were drilled for this study. These borings were the only accessible borings in the project site. This work was conducted as Phase one operation.

Phase two operation will consist drilling all the remained borings after access is cleared to us. A Geotechnical Engineering Report will consist final geotechnical design recommendations for all the planned structures will be provided after Phase two operation is completed. The planned structures locations covered by this report is shown on the attached **Site Locations**.

2.0 FIELD AND LABORATORY TESTING

Our field exploration was divided into two phases. The first phase consisted of drilling all the accessible boring locations in the project site. The second phase will include drilling all the inaccessible boring locations. It is our understanding that accessibility to these boreholes will be provided to us by the Texas Parks and Wildlife Department. The subsurface conditions encountered in the first operation is explained in the following sections.

2.1 SUBSURFACE CONDITIONS

2.1.1 Borings and Laboratory Tests

Conditions encountered at each boring location are indicated on the boring logs in **Appendix A**. Thin walled tubes and Standard Penetration Tests (SPTs) were used to sample cohesive soils and cohesionless soils, respectively. Load carrying capacity of bedrock was determined at the field by Texas Cone Penetration (TCP) tests and in our laboratory by uniaxial compressive strength tests on the rock core samples. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual.



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Geotechnical



Environmental



Construction Materials



Facilities

Geotechnical Bridge Memorandum

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas

August 17, 2020 ■ Terracon Project No. 94175276



Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ± 20 feet) and approximate elevations were not available at the time of preparing this report, we used Google Earth to determine the borings' elevations. If elevations and a more precise boring layout are desired, we recommend boring locations to be surveyed.

Laboratory tests performed included Atterberg limits, natural moisture content tests, unconfined compressive strength tests in soils, uniaxial compressive strength tests in rock, unit weight tests, percent passing No. 200 sieves and Sulfate tests. Results of these laboratory tests are presented in the boring logs. The tests were performed in general accordance with TXDOT standards.

2.1.2 Subsurface Conditions

BUILDING BORINGS	
Subsurface Conditions in Borings SB-2 and SB-3	
Clay	Clay soil was encountered at the ground surface and extended to a depth approximately 13.5 to 20 feet below the existing surface. In boring SB-3, clay soil was encountered below sandstone at approximately 21 feet below the existing surface and extended to the termination depths. The stiffness ranged from stiff to very stiff. The plasticity indices ranged from 17 to 29. The color ranged from brown to dark brown. Varied amounts of sands encountered within the boring depth.
Weathered Shale	It was encountered in boring SB-2, at approximately 20 feet below the existing surface and continued to the termination depth. The hardness was soft to hard. Seams of sandstone were observed with the encountered depth of weathered shale. The color was tan to brown
Sandstone	It was encountered in boring SB-3 at depth approximately 13.5 feet below the existing surface and continued to approximately 21 feet. The hardness was hard. The color was reddish brown.
Subsurface Conditions in Boring SB-8	
Clay	Clay soil was encountered at the ground surface and extended to a depth approximately 15 feet below the existing surface. The stiffness ranged from stiff to hard. The plasticity indices ranged from 21 to 30. The color ranged from tan to brown and gray.
Weathered Shale	It was encountered at depth approximately 15 feet below the existing surface and continued to the termination depth. The hardness was soft to hard. The color was tan

RETAINING WALLS BORINGS	
Subsurface Conditions in Borings RW-1, RW-3 Through RW-5	
Sandstone	In borings RW-1 only, sandstone was encountered at the ground surface and continued to the termination depths. The hardness ranged from hard to very hard. The color was tan and reddish brown. Sands seams were observed at varied depths of the encountered sandstone.
Clay	In borings RW-3 through RW-5, clay soil was encountered at the ground surface and extended to a depth approximately ranged from 0.25 to 5 feet below the existing surface. The stiffness ranged from very stiff to hard. The plasticity indices ranged from 44 to 47. The color was brown to reddish tan.

Geotechnical Bridge Memorandum

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas

August 17, 2020 ■ Terracon Project No. 94175276



RETAINING WALLS BORINGS	
Limestone	In borings RW-3 through RW-5, limestone was encountered about 0.25 to 6 feet below the existing surface and extended to the termination depths. The hardness ranged from hard to very hard. The color ranged from light gray to gray and reddish brown
Subsurface Conditions in Borings RW-8, RW-10, RW-13 and RW-14	
Clay	In borings RW-8, RW-10, and RW-14, about 1.5 to 8 feet of clay was encountered. The plasticity indices ranged from 18 to 21. The stiffness ranged from stiff to very stiff. The color ranged from reddish tan and brown to brown
Weathered Shale	It was only encountered in boring RW-8 about 8 feet and continued to approximately 34 feet below the existing surface. The hardness was soft to very hard. The color was tan and gray
Shale	It was only encountered in boring RW-8 at a depth approximately 34 feet below the existing surface and extended to the termination depth. The hardness was very hard. The color was gray and brown
Sand	About 1.5 to 3 feet of sand was only encountered in boring RW-13 and RW-14. The relative density ranged from slight compact to very dense. The color ranged from light gray to reddish brown and light red to red
Limestone	It was encountered in borings RW-10, RW-13, and RW-14, approximated depths of 1.5 to 3 feet below the existing surface and extended to the termination depths of the borings. The hardness was hard to very hard. The color ranged from light gray to gray
Subsurface Conditions in Boring RW-19	
Sand	About 0.5 feet of sand with varied amounts of sandstone and gravel was encountered. The color was tan
Sandstone	Encountered about 0.5 feet and extended to the termination depth. The hardness was very hard. The color was tan and reddish brown and light gray to gray.
Subsurface Conditions in Borings RW-24, RW-26, and RW-27	
Sand	Encountered to the termination depth in boring RW-24, the relative density was slightly compact to compact. The color was reddish brown. About 3.5 feet of sand underlain by clay was encountered in boring RW-26. The relative density was very dense, the color was brown to dark brown. Sand was not encountered in the other borings
Clay	Encountered about 3.5 feet in boring RW-26 and continued to the termination depth. The stiffness was very stiff. The plasticity index was 19. The color ranged from brown to dark brown and tan to gray. In boring RW-27, about 2 feet of clay underlain by gravel, and follows by clay to a depth approximately 18.5 feet below the existing surface. The stiffness was very stiff. The plasticity indices ranged from 18 to 28. The color ranged from brown to dark brown and tan to gray
Gravel	About 1.5 feet of gravel was encountered in boring RW-27 only. The color was tan
Weathered Shale	It was only encountered in boring RW-27 at approximately 18.5 feet and continued to the termination depth. The hardness was hard. The color was tan and gray
Subsurface Conditions in Boring RW-28	
Sand	About 7.5 feet of sand follows by gravel was encountered. The relative density was very loose. The color was brown
Gravel	About 6 feet of gravel underlain by clay was encountered. The relative density was slightly compact. The color was tan and brown. Varied amounts of sand and clay were encountered within the boring depth
Clay	About 5.5 feet thickness underlain by shale. The stiffness was hard. The color was tan and gray.

Geotechnical Bridge Memorandum

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas

August 17, 2020 ■ Terracon Project No. 94175276



RETAINING WALLS BORINGS	
Shale	Encountered about 19 feet below the existing ground surface and continued to the termination depth. The hardness ranged from hard to very hard. The color was tan to gray.

CULVERT BOX AND EMBANKMENT BORINGS	
Subsurface Conditions in Boring C-1 and C-2	
Gravel	About 5 to 9 feet of gravel was encountered in both borings. The relative density ranged from loose to dense. The color was tan
Weathered Shale	In boring C-1, weathered shale was encountered at approximate depth of 5 feet and extended to the termination depth. However, in boring C-2, weathered shale was encountered about 9 feet below the existing surface and continued to a depth approximately 15 feet. The hardness ranged from soft to hard. The color was gray
Shale	It was encountered in boring C-1 only at depth approximately 15 feet below the existing surface and continued to the termination depth. The hardness was hard to very hard. The color was gray. Sandstone seam was encountered within the boring depth.

PAVEMENT BORINGS	
Subsurface Conditions in Boring P-1 and P-2	
Clay	In boring P-1, clay was encountered at the ground surface and extended to the termination depth. in boring P-2, about 5 feet of clay underlain by sand and follows by another 5 feet of clay was encountered. The stiffness ranged from soft to hard. The color ranged from tan and reddish brown to brown and gray.
Sand	Encountered in boring P-2 only, at depth approximately 5 and extended to approximated depth of 10 feet below the existing surface. The relative density was loose. The color was reddish brown.
Highly Weathered Shale	Encountered in boring P-2 only, about 15 feet below the existing surface and continued to the termination depth. the stiffness was stiff.
Subsurface Conditions in Boring P-3 and P-12	
Gravel	In boring P-3, gravel was encountered at the ground surface and extended to about 1.5 feet below the existing surface, also gravel was encountered at depth approximately 13 feet and extended to about 18 feet below the existing surface. The color was tan to brown
Clay	About 2 to 15 feet of clay was encountered in both borings. The stiffness ranged from very stiff to hard. The plasticity indices ranged from 14 to 27. The color ranged from tan and light brown to brown
Sand	Encountered about 11 feet and extended to a depth approximately 13 feet below the existing surface. Sand was encountered in boring B-3 only
Weathered Shale	Encountered in boring P-12 only, about 15 feet depth and extended to the termination depth.
Subsurface Conditions in Boring P-4 through P-6	
Clay	About 13.5 to 16.5 feet of clay underlain by gravel was encountered. The stiffness ranged from soft to very stiff. The plasticity indices ranged from 12 to 20. The color ranged from brown and dark brown to reddish brown
Gravel	Encountered below the clay soils and extended to the termination depth. The relative density was dense. The color was tan

Geotechnical Bridge Memorandum

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas

August 17, 2020 ■ Terracon Project No. 94175276



PAVEMENT BORINGS	
Subsurface Conditions in Boring P-7 and P-8	
Clay	About 8.5 to 12 feet of clay underlain by gravel was encountered. The stiffness ranged from stiff to hard. The plasticity indices ranged from 12 to 17. The color ranged from brown to dark brown
Gravel	Encountered below the clay soils and extended to the termination depth. The relative density was loose to very dense. The color was brown and tan

2.1.3 Ground Water Observations

The borings were advanced using dry auger drilling techniques in clay which allows short-term groundwater observations to be made while drilling. Wash drilling technique was used in weathered and massive rock. Groundwater seepage observations are presented in the table below.

Structure type	Borings	Groundwater Seepage Depth (ft.), While Drilling	Groundwater Seepage Depth (ft.), After Drilling
Building	SB-2	Not Observed	Not Observed
	SB-3	Not Observed	Not Observed
	SB-8	Not Observed	Not Observed
Retaining Walls	RW-1	Not Observed	Not Observed
	RW-3	Not Observed	Not Observed
	RW-4	Not Observed	Not Observed
	RW-5	Not Observed	Not Observed
	RW-8	Not Observed	Not Observed
	RW-10	Not Observed	Not Observed
	RW-13	Not Observed	Not Observed
	RW-14	Not Observed	Not Observed
	RW-19	Not Observed	Not Observed
	RW-24	Not Observed	Not Observed
	RW-26	Not Observed	Not Observed
	RW-27	Not Observed	Not Observed
	RW-28	15	15

Geotechnical Bridge Memorandum

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas

August 17, 2020 ■ Terracon Project No. 94175276



Structure type	Borings	Groundwater Seepage Depth (ft.), While Drilling	Groundwater Seepage Depth (ft.), After Drilling
Culvert Box	C-1	2	2
Embankment	C-2	Not Observed	Not Observed
Pavements	P-1	15	Not Observed
	P-2	14	16
	P-3	Not Observed	Not Observed
	P-4	Not Observed	Not Observed
	P-5	19	Not Observed
	P-6	Not Observed	Not Observed
	P-7	Not Observed	Not Observed
	P-8	18	16
	P-12	Not Observed	Not Observed

Due to the low permeability of the soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the construction plans for the project.

3.0 DESIGN FOUNDATION RECOMMENDATIONS

Based on the encountered subsurface conditions near the footprint of the planned structures, we developed our preliminary design recommendations as listed in the following table.

Type of Structure	Borings Drilled	Allowable Bearing Pressure (psf.)
Building	SB-2 and SB-3	3,500
Building	SB-8	3,500

Geotechnical Bridge Memorandum

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas

August 17, 2020 ■ Terracon Project No. 94175276



Type of Structure	Borings Drilled	Allowable Bearing Pressure (psf.)
Retaining Wall	RW-1, RW-3 through RW-5	2,250 ¹ , 8,000 ²
Retaining Wall	RW-8, RW-10, RW-13 and RW-14	3,500
Retaining Wall	RW-19	8,000 ²
Retaining Wall	RW-24, RW-26, and RW-27	4,000
Retaining Wall	RW-28	750
Culvert Box	C-1	5,000
<p>1- Supported on Clay 2- Supported on Bedrock 3- Factor of Safety is 3.0 4- The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.</p>		

4.0 GENERAL COMMENTS

Our preliminary analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Geotechnical Bridge Memorandum

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas

August 17, 2020 ■ Terracon Project No. 94175276



Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

5.0 CLOSURE

Please do not hesitate to contact us if there are any questions.

Sincerely,

Terracon Consultants, Inc.

Terracon Registration No. 3272

Ali Q. Abdullah, P.E.
Project Engineer

Siva P. Pathivada, P.E.
Texas Transportation Program Manager
Principal

Attachments

Site Location
Exploration Plan

Appendix A
Boring Logs and Borings Layout

EXHIBITS

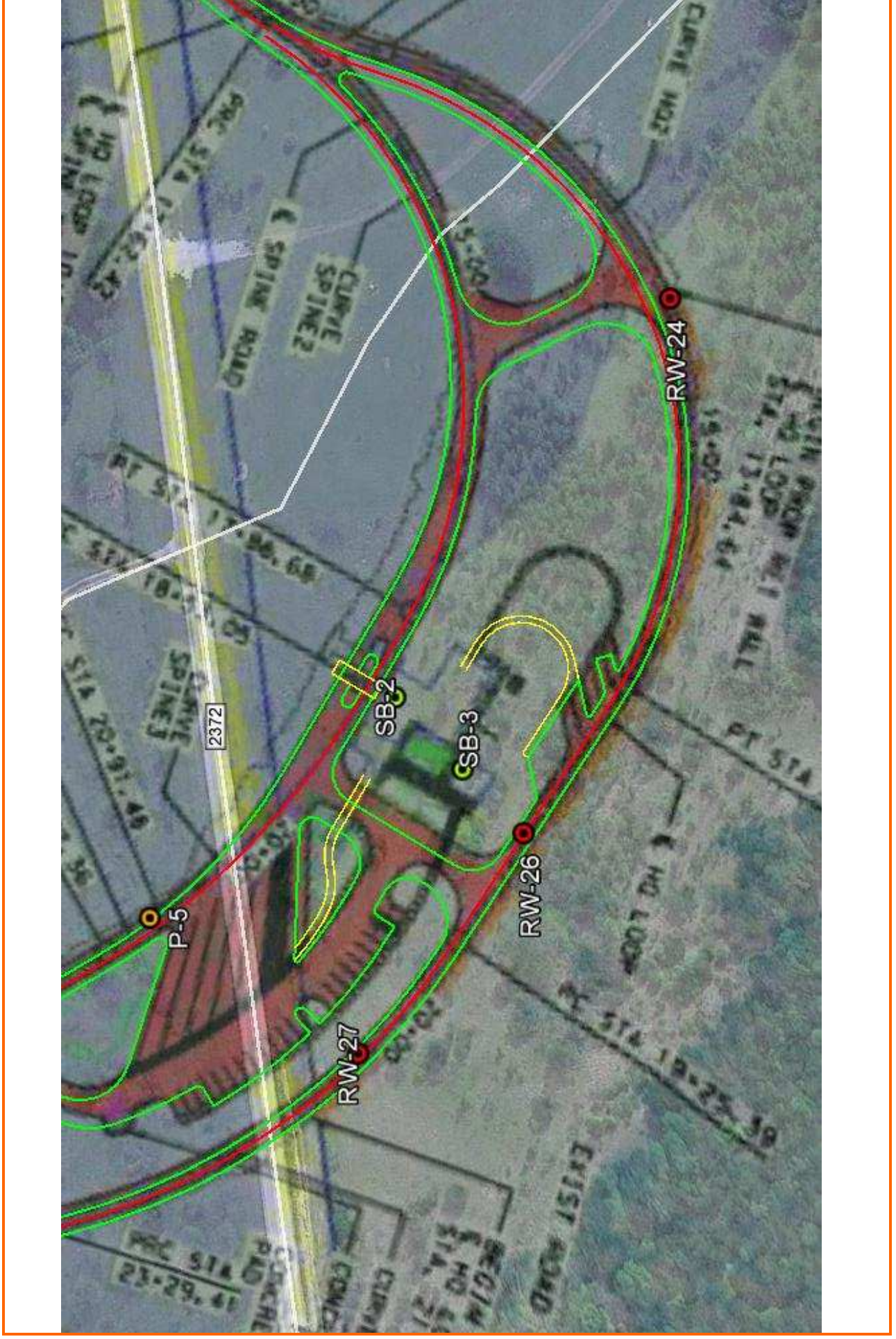
SITE LOCATION

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas
August 17, 2020 ■ Terracon Project No. 94175276



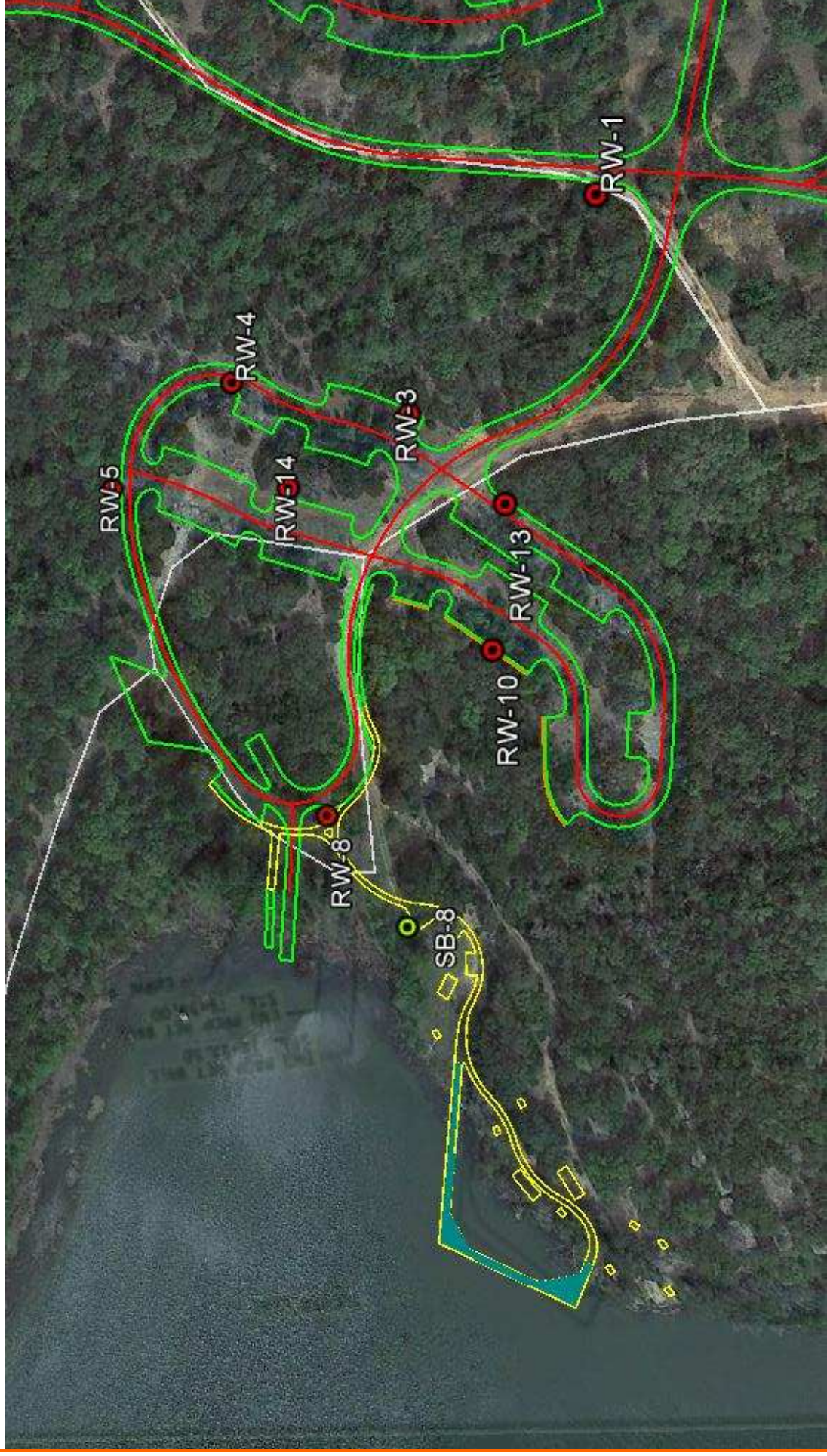
EXPLORATION PLAN

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas
August 17, 2020 ■ Terracon Project No. 94175276



EXPLORATION PLAN

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas
August 17, 2020 ■ Terracon Project No. 94175276



EXPLORATION PLAN

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas
August 17, 2020 ■ Terracon Project No. 94175276





EXPLORATION PLAN

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas
August 17, 2020 ■ Terracon Project No. 94175276







EXPLORATION PLAN

Palo Pinto Mountains State Park ■ Strawn, Palo Pinto County, Texas
August 17, 2020 ■ Terracon Project No. 94175276



APPENDIX A

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole SB- 2
Structure Building
Station N/A
Offset

District Fort Worth
Date 5/15/2020
Grnd. Elev. 1082.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, stiff to very stiff, dark brown to brown, sandy (CL)							
						10				SPT=15/12in.
						10	30	17		#200(%)-56; PP=4.5+
5		18 (6) 14 (6)		0	53	12			133	PP=4.5+
										PP=4.5+
10		9 (6) 12 (6)								PP=4.5+
15		14 (6) 21 (6)		0	71	13			134	PP=4.5+

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53498 Longitude: -98.5569

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole SB- 2
Structure Building
Station N/A
Offset

District Fort Worth
Date 5/15/2020
Grnd. Elev. 1082.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1062. 20		50 (5) 43 (6)	CLAY, stiff to very stiff, dark brown to brown, sandy (CL)							
						16	43	29		#200(%)-73; PP=4.5+
1057. 25		50 (3.5) 50 (1)	SHALE, soft to hard, brown and tan, weathered, with seams of sandstone			10				
										SPT=50/4in.
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53498 Longitude: -98.5569

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole SB- 3
Structure Building
Station N/A
Offset

District Fort Worth
Date 5/15/2020
Grnd. Elev. 1089.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, stiff to very stiff, dark brown to brown, with sand (CL)							
						10	35	22		#200(%)-55; PP=4.5+
				0	47	9			129	PP=4.5+
5		15 (6) 14 (6)				11				PP=4.5+
										PP=4.5+
10		24 (6) 28 (6)		0	73	13	42	28	133	PP=4.5+
1075.5			SANDSTONE, hard, reddish tan			4				#200(%)-22; PP=4.5+
15		50 (1) 50 (0.25)								SPT=50/1in.

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53484 Longitude: -98.55708

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole SB- 3
Structure Building
Station N/A
Offset

District Fort Worth
Date 5/15/2020
Grnd. Elev. 1089.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SANDSTONE, hard, reddish tan							
20		50 (1) 50 (0.25)				4				SPT=50/1in.
1068.			CLAY, very stiff, tan and light gray, shaley (CH)							21-29-31; N=60
1064. 25		29 (6) 35 (6)								SPT=60/12in.
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53484 Longitude: -98.55708

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole SB- 8
Structure Building
Station N/A
Offset

District Fort Worth
Date 6/4/2020
Grnd. Elev. 1127.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, stiff to very stiff, brown, sandy (CL)							
				0	158	12				PP=4.5+
5		32 (6) 27 (6)								PP=4.5+
										PP=4.5+
1117. 10		13 (6) 12 (6)	CLAY, stiff to hard, tan and gray, shaley (CL)			8	34	21		#200(%)-25; PP=4.5+
1112 15		50 (4.5) 50 (4)		0	15	16	49	30		PP=4.5+

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53129 Longitude: -98.56451

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

DRILLING LOG

2 of 2

Hole SB- 8
Structure Building
Station N/A
Offset

District Fort Worth
Date 6/4/2020
Grnd. Elev. 1127.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SHALE, soft to hard, tan, weathered							
20		50 (4) 50 (3)								PP=4.5+
						13				#200(%)-98
1102. 25		50 (1.5) 50 (1.5)								SPT=50/6in.
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53129 Longitude: -98.56451

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 1
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/16/2020
Grnd. Elev. 1210.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SANDSTONE, hard, tan and reddish brown, with sand seams	0	4963	2			131	CORE RUN 0-5' REC=78%, RQD=50%
5		50 (1.5) 50 (0.75)		0	2857	4			133	
10		50 (0.25) 50 (0)		0	2545	2			131	
										CORE RUN 5-10' REC=82%, RQD=75%
1196.			SANDSTONE, very dense, reddish brown and tan, with sand seams							CORE RUN 10-15' REC=97%, RQD=67%
15		50 (0.25) 50 (0.25)		0	1673	6			128	

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53285 Longitude: -98.56586

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

DRILLING LOG

2 of 2

Hole RW- 1
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/16/2020
Grnd. Elev. 1210.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1190.20		50 (0.5) 50 (0.25)	SANDSTONE, very dense, reddish brown and tan, with sand seams							CORE RUN 15-20' REC=95%, RQD=66%
25										
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53285 Longitude: -98.56586

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 3
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/3/2020
Grnd. Elev. 1177.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1172.5		50 (0.5) 50 (0.25)	CLAY, very stiff to hard, brown (CH)							PP=4.5+
						63	44			PP=4.5+
			LIMESTONE, very stiff to hard, tan							PP=4.5+
1167.5	10	50 (2.75) 50 (0.25)		0	11644	0			164	CORE RUN 5-10' REC=47%, RQD=27%
			LIMESTONE, hard to very hard, gray							
										CORE RUN 10-15' REC=67%, RQD=27%
15		50 (0.25) 50 (0.25)								

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53215 Longitude: -98.56577

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 3
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/3/2020
Grnd. Elev. 1177.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1157.20		50 (0.25) 50 (0.25)	LIMESTONE, hard to very hard, gray	0	5828	0			163	CORE RUN 15-20' REC=98%, RQD=68%
25										
30										
<p>Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53215 Longitude: -98.56577</p> <p>The ground water elevation was not determined during the course of this boring.</p>										

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 4
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/29/2020
Grnd. Elev. 1172.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1170.5			CLAY, very stiff, moist, reddish tan (CH)	0	21	19			123	PP=4.5+
			CALICHE, dense to very dense, with clay				67	47		PP=4.5+
1169.			LIMESTONE, hard to very hard, light gray, with horizontal fractures and clay layers							
5		50 (0.25) 50 (0)								
10		50 (2) 50 (1.5)								
15		50 (2) 50 (2)								

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.5318 Longitude: -98.56625

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 4
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/29/2020
Grnd. Elev. 1172.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1152.20		50 (2.5) 50 (1.25)	LIMESTONE, hard to very hard, light gray, with horizontal fractures and clay layers	0	6738	0			168	CORE RUN 15-20' REC=67%, RQD=42%
25										
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.5318 Longitude: -98.56625

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 5
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/29/2020
Grnd. Elev. 1158.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1157.8			CLAY (CL) LIMESTONE, hard, light gray, with frequent horizontal fractures							
5		50 (1.75) 50 (1)								CORE RUN 1-5' REC=100%, RQD=58%
10		50 (0.5) 50 (0.25)								CORE RUN 5-10' REC=50%, RQD=10%
15		50 (2.5) 50 (1)								CORE RUN 10-15' REC=50%, RQD=0%

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53131 Longitude: -98.56628

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 5
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/29/2020
Grnd. Elev. 1158.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1138.20		50 (2) 50 (1.25)	LIMESTONE, hard, light gray, with frequent horizontal fractures							CORE RUN 15-20' REC=30%, RQD=47%
25										
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53131 Longitude: -98.56628

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 3



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 8
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/4/2020
Grnd. Elev. 1125.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, stiff, brown, sandy (CL)							
							34	18		PP=4.5+
										PP=4.5+
5		13 (6) 18 (6)					35	21		PP=4.5+
1117.			SHALE, soft to very hard, tan and gray, weathered							PP=4.5+
10		50 (5.5) 50 (4.75)		0	124	13	44	25	138	PP=4.5+
						13				#200(%)-94
15		50 (2) 50 (1.25)								PP=4.5+

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53128 Longitude: -98.56496

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 3



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 8
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/4/2020
Grnd. Elev. 1125.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SHALE, soft to very hard, tan and gray, weathered							
20		50 (5.25) 50 (2.5)								CORE RUN 15-20' REC=25%, RQD=0%
25		50 (2.75) 50 (1.25)								CORE RUN 20-25' REC=57%, RQD=12%
30		50 (3.25) 50 (2.75)								CORE RUN 25-30' REC=85%, RQD=27%

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53128 Longitude: -98.56496

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

3 of 3



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW- 8
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/4/2020
Grnd. Elev. 1125.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1091.			SHALE, soft to very hard, tan and gray, weathered							CORE RUN 30-35' REC=85%, RQD=0%
35		50 (0.5) 50 (0.25)	SHALE, very hard, gray and brown							
1085. 40		50 (0.25) 50 (0.25)								CORE RUN 35-40' REC=97%, RQD=0%
45										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53128 Longitude: -98.56496

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-10
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/1/2020
Grnd. Elev. 1163.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1161.5			CLAY, very stiff, dry, reddish brown, sandy (CH)							
			LIMESTONE, very hard, light gray, with frequent horizontal fractured			12				PP=4.5+
5		50 (0.25) 50 (0.25)		0	6128	1			164	
										CORE RUN 5-10' REC=95%, RQD=7%
10		50 (0.25) 50 (0.25)		0	3984	1			165	
										CORE RUN 15-20' REC=78%, RQD=8%
15		50 (0.25) 50 (0.25)		0	5277	1			158	

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53196 Longitude: -98.56503

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.



DRILLING LOG

2 of 2

WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-10
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/1/2020
Grnd. Elev. 1163.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1143.20		50 (0.5) 50 (0.25)	LIMESTONE, very hard, light gray, with frequent horizontal fractured							CORE RUN 20-25' REC=58%, RQD=22%
25										
30										
<p>Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53196 Longitude: -98.56503</p> <p>The ground water elevation was not determined during the course of this boring.</p>										

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-13
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/2/2020
Grnd. Elev. 1179.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1177.			SAND, slightly compact, reddish brown, clayey (SC)							
1176.			CALICHE, very dense, moist, light gray			14				
			LIMESTONE, very hard, light gray, with frequent horizontal fractured							
5		50 (0.75) 50 (0.25)								
10		50 (0.5) 50 (0.5)								
15		50 (0.5) 50 (0)		0	7685	0			165	

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.532222 Longitude: -98.56535

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG



WinCore
Version 3.3

County	Palo Pinto
Highway	N/A
CSJ	N/A

Hole	RW-13
Structure	Retaining Wall
Station	N/A
Offset	

District	Fort Worth
Date	6/2/2020
Grnd. Elev.	1179.00 ft
GW Elev.	N/A

[illegible]

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.532222 Longitude: -98.56535

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-14
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/29/2020
Grnd. Elev. 1169.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1167.5			CLAY, stiff, moist, reddish tan, sandy, with sandstone fragments (CL)							
			SANDSTONE, dense to very dense, red to light red, crystalline with clay seams			22				PP=4.5+
1166.			LIMESTONE, hard to very hard, gray, with horizontal fractures							
5		50 (0.25) 50 (0)		0	8589	0			163	
										CORE RUN 5-10' REC=100%, RQD=27%
10		50 (2) 50 (1.5)		0	9225	1			165	
										CORE RUN 10-15' REC=77%, RQD=7%
15		50 (2) 50 (2)								

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53176 Longitude: -98.56585

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-14
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/29/2020
Grnd. Elev. 1169.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1149.20	LOG	50 (2.5) 50 (1.25)	LIMESTONE, hard to very hard, gray, with horizontal fractures							CORE RUN 15-20' REC=88%, RQD=0%
25										
30										
<p>Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53176 Longitude: -98.56585</p> <p>The ground water elevation was not determined during the course of this boring.</p>										

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-19
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/15/2020
Grnd. Elev. 1177.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1176.5			SAND, tan, with sandstone and gravel							CORE RUN 0-5' REC=72%, RQD=10%
			SANDSTONE, very hard, reddish brown, orange and gray, with clay seams							
1172.5		50 (0.25) 50 (0)		0	1645	2			127	CORE RUN 5-10' REC=76%, RQD=45%
			SANDSTONE, very hard, tan and light gray, poorly cemented, with sand seams							
1167.10		50 (0.25) 50 (0.25)		0	2624	3			127	CORE RUN 10-15' REC=93%, RQD=42%
			SANDSTONE, very hard, tan to reddish brown							
1163.5										
			SANDSTONE, very hard, tan							
15		50 (0.25) 50 (0.25)		0	3264	0			120	

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.532258 Longitude: -98.567809

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

DRILLING LOG

2 of 2

Hole RW-19
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 6/15/2020
Grnd. Elev. 1177.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1157.20		50 (0.25) 50 (0.25)	SANDSTONE, very hard, tan							CORE RUN 15-20' REC=93%, RQD=78%
25										
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.532258 Longitude: -98.567809

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Sean O'Connor

Organization: Terracon Consultants, Inc.



DRILLING LOG

1 of 2

WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-24
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/18/2020
Grnd. Elev. 1089.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SAND, slightly compact to compact, reddish brown (SC)							
						17				PP=1.5
				0	102	12	31	17	137	#200(%)-40; PP=4.5
5		15 (6) 17 (6)		0	88	7			136	PP=4.5+
							28	14		PP=4.5+
10		26 (6) 30 (6)				8				#200(%)-45; SPT=64/12in.
15		16 (6) 16 (6)				8				SPT=69/12in.

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.5344 Longitude: -98.5559

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-24
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/18/2020
Grnd. Elev. 1089.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1069.20		27 (6) 27 (30)	SAND, slightly compact to compact, reddish brown (SC)			14				PP=54/12in.
25										
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.5344 Longitude: -98.5559

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-26
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/18/2020
Grnd. Elev. 1095.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1091.5			SAND, very dense, dark brown to brown, with sand (SC)			14				PP=4.5+
			CLAY, very stiff, brown, gravelly (CL)			8	33	19		#200(%)-48; PP=4.5+
										PP=4.5+
5		25 (6) 43 (6)								
1086.5				0	73	8			127	PP=4.5+
			CLAY, very stiff, tan and gray, shaley (CH)							
						4				#200(%)-24; SPT=54/12in.
10		31 (6) 42 (6)								
15										
						10				SPT=57/12in.
		30 (6) 45 (6)								

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53471 Longitude: -98.55723

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-26
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/18/2020
Grnd. Elev. 1095.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, very stiff, tan and gray, shaley (CH)							
						10				
1075.20		32 (6) 47 (6)								SPT=64/12in.
25										
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53471 Longitude: -98.55723

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-27
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/18/2020
Grnd. Elev. 1086.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1084.			CLAY, very stiff, dark brown to brown, with sand (CL)	0	44	16				#200(%)-62; PP=4.5+
			GRAVEL, tan, clayey				35	18		PP=4.5+
1082.5			CLAY, stiff, brown and tan, with gravel (CL)							
5		11 (6) 12 (6)				9				SPT=28/12in.
1080.			CLAY, very stiff, tan and gray, shaley (CH)							SPT=31/12in.
10		16 (6) 29 (6)				47	28			SPT=52/12in.
15		28 (6) 28 (6)								SPT=43/12in.

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53506 Longitude: -98.55779

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

2 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-27
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/18/2020
Grnd. Elev. 1086.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1067.5			CLAY, very stiff, tan and gray, shaley (CH)							
			SHALE, hard, tan and gray, weathered			10				
1066.20		50 (4.25) 50 (3.25)								SPT=50/4in.
25										
30										

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53506 Longitude: -98.55779

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 2



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-28
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/20/2020
Grnd. Elev. 1179.00 ft
GW Elev. 1164.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SAND, very loose, brown (SC)							
						4				PP=1.0
							45	28		PP=0.5
5		4 (6) 5 (6)				4				#200(%)-15; PP=0.5
1171.5			GRAVEL, slightly compact, tan and brown, clayey, with sand			4				#200(%)-19; SPT=9/12in.
10		8 (6) 15 (6)					35	19		SPT=31/12in.
1165.5			CLAY, hard, tan and gray, shaley (CH)							
						0				
15		32 (6) 50 (5.75)								SPT=50/5in.

Remarks: Seepage observed at 15' during drilling. Water at 15' at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53524 Longitude: -98.56032

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.



DRILLING LOG

2 of 2

WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole RW-28
Structure Retaining Wall
Station N/A
Offset

District Fort Worth
Date 5/20/2020
Grnd. Elev. 1179.00 ft
GW Elev. 1164.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1160.			CLAY, hard, tan and gray, shaley (CH)							
1159. 20		50 (1) 50 (1)	SHALE, hard to very hard, tan to gray			11				SPT=50/4.75in.
25										
30										

Remarks: Seepage observed at 15' during drilling. Water at 15' at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53524 Longitude: -98.56032

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole C- 1
Structure Culvert Box
Station N/A
Offset

District Fort Worth
Date 5/20/2020
Grnd. Elev. 1062.00 ft
GW Elev. 1060.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1057. 5		50 (4) 50 (3)	GRAVEL, medium dense to dense, with sand, fine grained, tan, angular to subrounded, with fine clay seams			5	29	16		#200(%)-17; SPT=20/12in.
										SPT=24/12in.
						16				SPT=41/12in.
10		50 (5) 50 (4)	SHALE, soft to hard, gray, weathered			11	45	27		#200(%)-92; SPT=50/5in.
										SPT=50/3in.
						12	43	24		
15		50 (1) 50 (0.5)								CORE RUN 10-15' REC=5%, RQD=0%
1042. 20		50 (0.5) 50 (0.25)								CORE RUN 15-20' REC=97%, RQD=83%

Remarks: Seepage observed at 2' during drilling. Water at 2' at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53769 Longitude: -98.56051

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole C- 2
Structure Culvert Box
Station N/A
Offset

District Fort Worth
Date 5/20/2020
Grnd. Elev. 0.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
5		47 (6) 50 (6)	GRAVEL, loose to compact, tan, with sand, fine to coarse grained, angular to subrounded, fine sand, few clay seams							SPT=83/11in.
-9.		50 (4.25) 50 (3.75)	SHALE, soft to hard, gray, weathered, with sandstone seams							CORE RUN 10-15' REC=32%, RQD=8%
-15.		50 (1.5) 50 (1)	SHALE, hard to very hard, gray, with sandstone seams							CORE RUN 15-20' REC=62%, RQD=32%
-20.		50 (1) 50 (0.5)								
<p>Remarks: No Seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: Longitude:</p> <p>The ground water elevation was not determined during the course of this boring.</p>										

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P- 1
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 5/14/2020
Grnd. Elev. 1036.00 ft
GW Elev. 1021.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, very stiff to hard, reddish tan, trace gravel (CL)							SPT=25/12in.
						3				SPT=29/12in. #200(%)-90
5		43 (6) 50 (6)								
1029.			CLAY, soft to hard, light brown, sandy, trace to few silty sand particles, trace gravel layers (CL)			8				#200(%)-91; SPT=22/12in.
										SPT=12/12in.
10		11 (6) 12 (6)								
						7				#200(%)-59; SPT=11/12in. gravel laer at 13'
15		5 (6) 5 (6)								SPT=24/12in., gravel layer at 15'
1016. 20		40 (6) 45 (6)				10				SPT=85/12in.

Remarks: Seepage observed at 15' during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.54934 Longitude: -98.5309

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P- 2
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 5/21/2020
Grnd. Elev. 1080.00 ft
GW Elev. 1066.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1075.5		8 (6) 8 (6)	CLAY, very stiff, brown, with sand (CL)			7				PP=2.5; SS=40ppm
						10				#200(%)-81; PP=4.5+; SS=80ppm
										PP=4.5+
1070.10		10 (6) 10 (6)	SAND, loose, reddish tan (SC)			4				PP=2.5
										#200(%)-8; PP=1.0
1065.15		18 (6) 28 (6)	CLAY, soft to stiff, tan and gray, sandy (CH)			11				SPT=15/12in.
										#200(%)-55; SPT=14/12in.
1060.20		22 (6) 12 (6)	SHALE, stiff, gray, highly weathered							SPT=70/8in.

Remarks: Seepage observed at 14' during drilling. Water at 16' at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.55092 Longitude: -98.53127

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P- 3
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 05/21/2020
Grnd. Elev. 1089.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1087.5			GRAVEL, brown, clayey							
			CLAY, very stiff, brown, with sand (CL)			11				PP=4.5+; SS=326ppm
5		20 (6) 23 (6)				9	30	17		#200(%)-80; PP=4.5+; SS=332ppm
1082.			CLAY, very stiff, tan, sandy (CL)							PP=4.5+
10		20 (6) 20 (6)				7	25	14		#200(%)-61; PP=4.5+
1078.			SAND, slightly compact to compact, reddish tan, clayey (SC)							
1076.			GRAVEL, compact, tan, sandy							SPT=16/12in.
15		27 (6) 35 (6)				2				SPT=39/12in.
1071.			CLAY, very stiff, tan and gray, gravelly (CH)							
20		23 (6) 29 (6)								SPT=32/12in.

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.55093 Longitude: -98.5338

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P- 4
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 5/19/2020
Grnd. Elev. 1071.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, soft, dark brown to reddish brown, with sand (CL)							SPT=8/12in.
						15	29	16		#200(%)-62; PP=3.0; SS=66ppm
5		7 (6) 8 (6)				14				PP=3.25; SS=80ppm
						12				PP=3.25
10		8 (6) 10 (6)								PP=3.5
						13	27	14		#200(%)-58; PP=2.0
1057.5			GRAVEL, dense, tan, with sand							PP=1.0
15		50 (4.5) 50 (3.5)								SPT=34/12in.
1051. 20		50 (4.75) 50 (5.25)								SPT=50/4in.

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53561 Longitude: -98.55468

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P- 5
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 5/15/2020
Grnd. Elev. 1095.00 ft
GW Elev. 1076.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, stiff, dark brown to reddish brown, sandy (CL)							SPT=16/12in.
						10	33	16		#200(%)=69; SPT=25/12in.; SS=60ppm
5		16 (6) 18 (6)								SPT=20/12in.; SS=40ppm
						11				SPT=26/12in.
10		25 (6) 26 (6)								SPT=42/12in.
						9	32	20		#200(%)=68; SPT=31/12in.
15		17 (6) 16 (6)								SPT=27/12in.
1078.5			GRAVEL, dense, tan, clayey, with sand			5				
1075. 20		44 (6) 50 (5)								

Remarks: Seepage observed at 19' during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.5355 Longitude: -98.55745

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P- 6
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 05/20/2020
Grnd. Elev. 1086.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1082.			CLAY, stiff to very stiff, brown, sandy (CL)							SPT=12/12in.
5		21 (6) 36 (6)	CLAY, stiff to very stiff, brown, sandy (CL)			4	25	13		PP=3.0 SS=80ppm
										#200(%)-43; PP=2.0, SS=60ppm
10		12 (6) 19 (6)				7				SPT=15/12in.
										SPT=30/12in.
						5	24	12		#200(%)-51; SPT=24/12in.
1071. 15		50 (3.25) 50 (2.5)	GRAVEL, dense, tan, clayey, with sand							SPT=33/12in.
1066. 20		50 (3.5) 50 (3.25)								SPT=50/4in.

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53719 Longitude: -98.56

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P- 7
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 5/19/2020
Grnd. Elev. 1084.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
1079.5		13 (6) 13 (6)	CLAY, stiff, brown, sandy (CL)							PP=1.5; SS=60ppm
						8				PP=4.5+; SS=60ppm
						8	28	12		#200(%)~45; PP=4.5+
1075.5		25 (6) 50 (4.5)	CLAY, stiff, brown, sandy (CL)							PP=4.5+
			GRAVEL, compact to dense, tan, with sand							SPT=61/12in.
						2				#200(%)~16
15		50 (4) 50 (2)								SPT=50/3in.
						4				
20		50 (3.25) 50 (1.75)								SPT=50/4in.

Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53506 Longitude: -98.5598

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.



DRILLING LOG

1 of 1

WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P- 8
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 5/14/2020
Grnd. Elev. 1092.00 ft
GW Elev. 1076.00 ft

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, very stiff to very hard, dark brown to brown, with sand (CL)							SPT=19/12in.
						5	27	13		#200(%) -90; SPT=26/12in.
5		28 (6) 33 (6)				5				SPT=58/12in.; SS=40ppm
										SPT=31/12in.
10		50 (2) 50 (2)				6	31	17		#200(%) -64; SPT=77/12in.
1080.			GRAVEL, loose to very dense, brown and tan, clayey, with sand							SPT=50/4in.
15		7 (6) 10 (6)								SPT=31/12in.
						6				
1072. 20		50 (2) 50 (0.5)								SPT=50/4in.

Remarks: Seepage observed at 18' during drilling. Water at 16' at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.53382 Longitude: -98.56169

Any ground water elevation information provided on this boring log is representative of conditions existing on the day and for the specific location where this information was collected. The actual groundwater elevation may fluctuate due to time, climatic conditions, and/or construction activity.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.

DRILLING LOG

1 of 1



WinCore
Version 3.3

County Palo Pinto
Highway N/A
CSJ N/A

Hole P-12
Structure Pavement
Station N/A
Offset

District Fort Worth
Date 5/14/2020
Grnd. Elev. 1089.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, very stiff to hard, light brown, sandy (CL)			7	30	15		SPT=19/12in.; SS=5,544ppm
										SPT=30/12in. SS=60ppm
5		33 (6) 28 (6)				5				#200(%)-56; SPT=53/12in.
										gravel layer at 7.5' to 8' SPT=32/12in.
10		28 (6) 50 (4.5)	SHALE, very hard, weathered			6				#200(%)-50; SPT=81/11in.
										SPT=41/12in.
						9	40	23		
1074. 15		50 (2) 50 (2)								
						8				
1069. 20		50 (2) 50 (1)								SPT=50/5in.

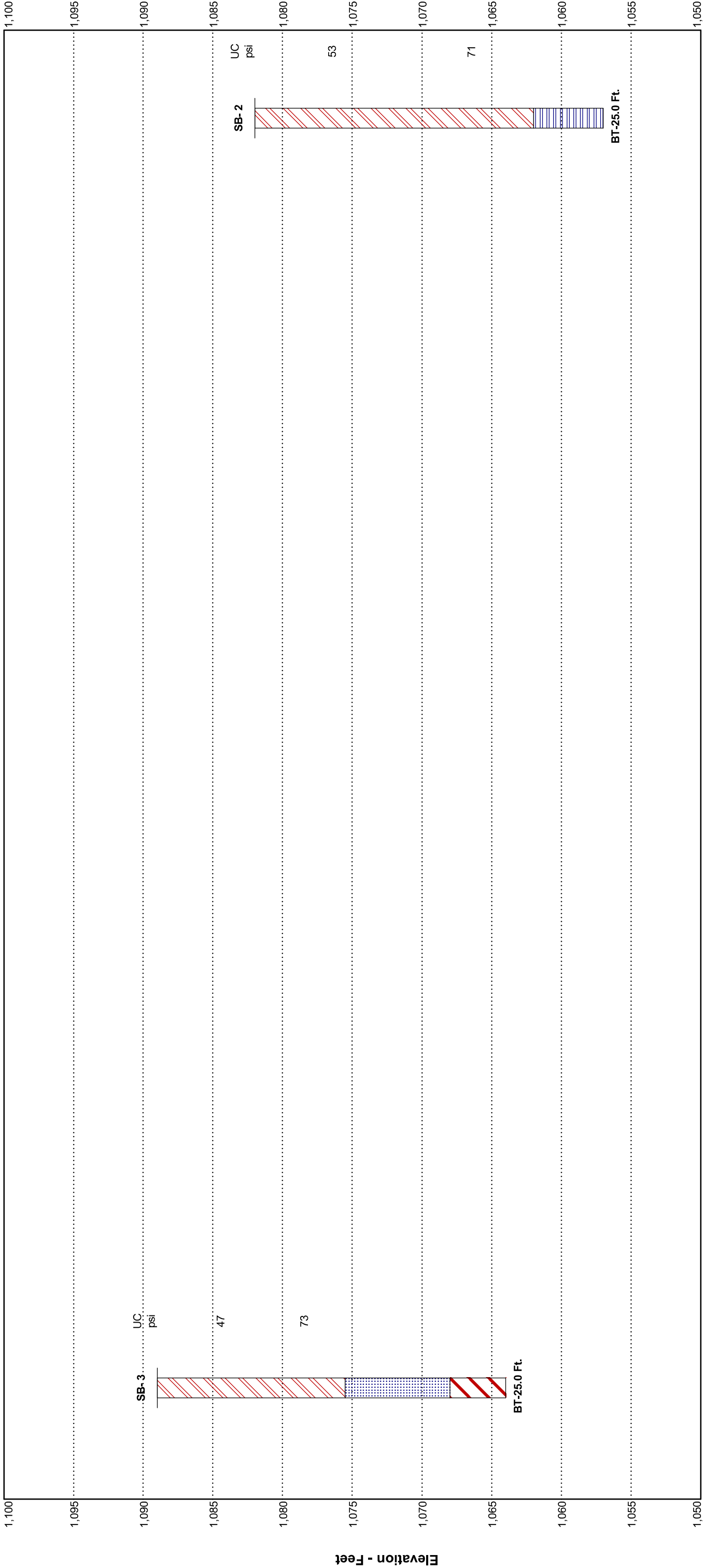
Remarks: No seepage observed during drilling. Dry at completion. GPS coordinates were obtained using the WGS-84 coordinate system. Elevations obtained from Google Earth. Latitude: 32.54925 Longitude: -98.53322

The ground water elevation was not determined during the course of this boring.

Driller: T. Dennis

Logger: Bradford Weddell

Organization: Terracon Consultants, Inc.



Explanation

Moisture Content — %w — ☒ SB- 2 — Borehole Number

Sampling — ☒ LL PL — Liquid and Plastic Limits

(See General Notes)

AR — Borehole

BT — Borehole

Water Level Reading at time of drilling. ☒ Water Level Reading after drilling. ☒

NOTES:

See Exhibit A-2 for orientation of soil profile.

See General Notes in Appendix C for symbols and soil classifications.

Soils profile provided for illustration purposes only.

Soils between borings may differ

AR - Auger Refusal

BT - Boring Termination

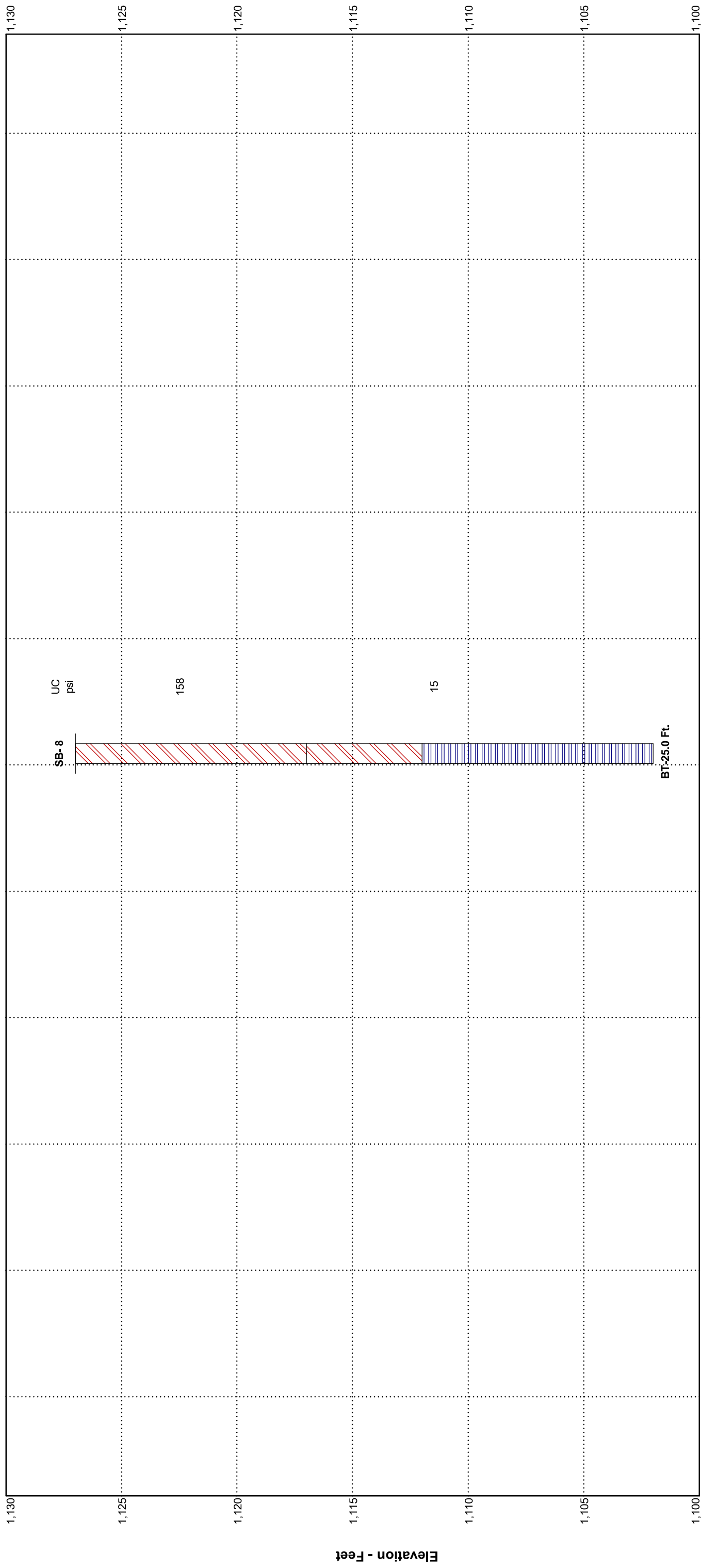
☒ TXDOT CL ☒ TXDOT SHALE ☒ TXDOT SANDSTONE ☒ TXDOT CH



Project Manager: Ali	Project No.: 94175276
Drawn by: AA	Scale: N.T.S.
Approved by:	File Name: 94175276
Date: 8/14/2020	

SUBSURFACE PROFILE	
PALO PINTO MOUNTAINS STATE PARK FM 2372 STRAWN, TX	

EXHIBIT	A-1
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TXDOT CL
TXDOT SHALE

Explanation

Moisture Content	Sampling	Termination Type	Borehole Number	LL PL	Liquid and Plastic Limits
SB-8	AR	BT	Water Level Reading at time of drilling.	Water Level Reading after drilling.	

(See General Notes)

NOTES:
See Exhibit A-2 for orientation of soil profile.
See General Notes in Appendix C for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project Manager: Ali
Drawn by: AA
Approved by:
Date: 8/14/2020

Project No.: 94175276
Scale: N.T.S.
File Name: 94175276



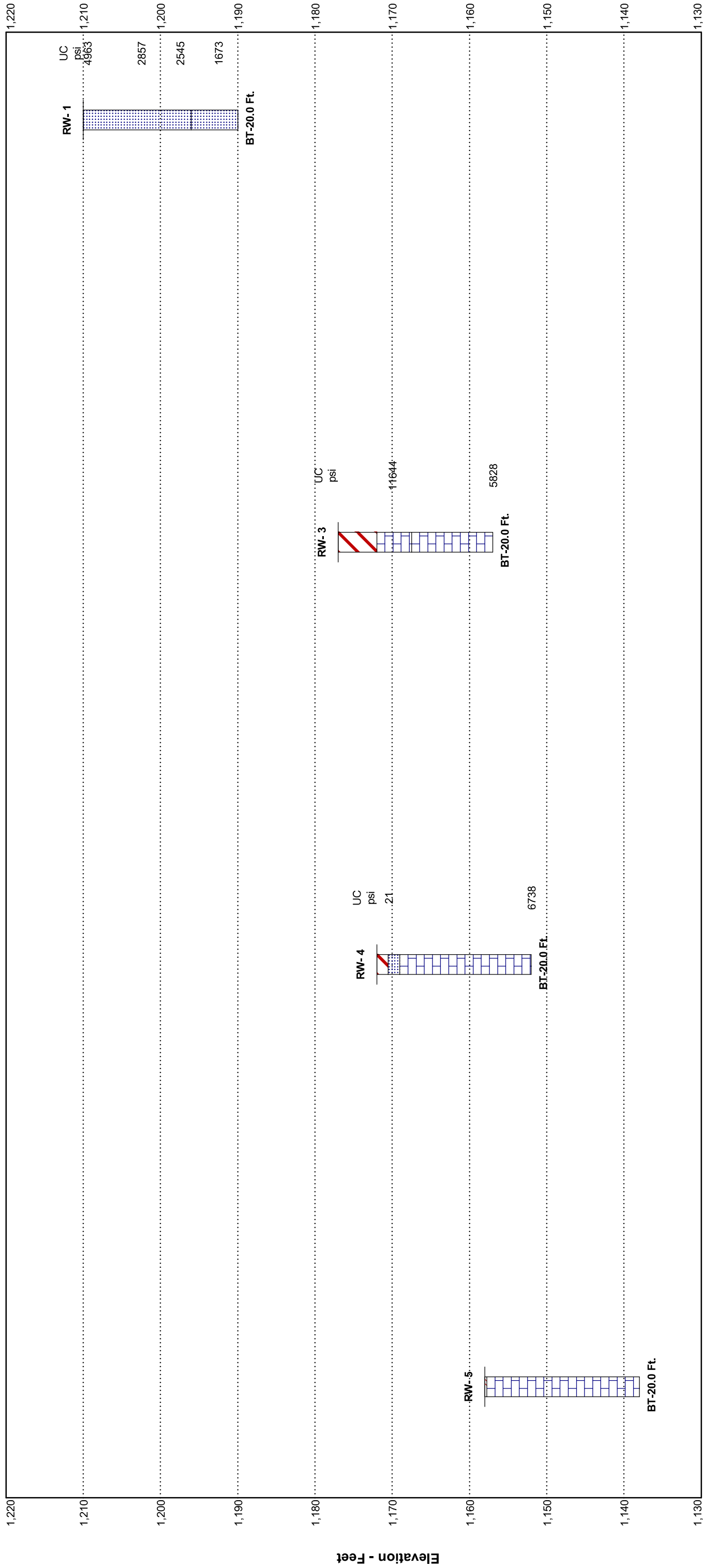
SUBSURFACE PROFILE

PALO PINTO MOUNTAINS STATE PARK
FM 2372
STRAWN, TX

PH. FAX.

A-2

EXHIBIT




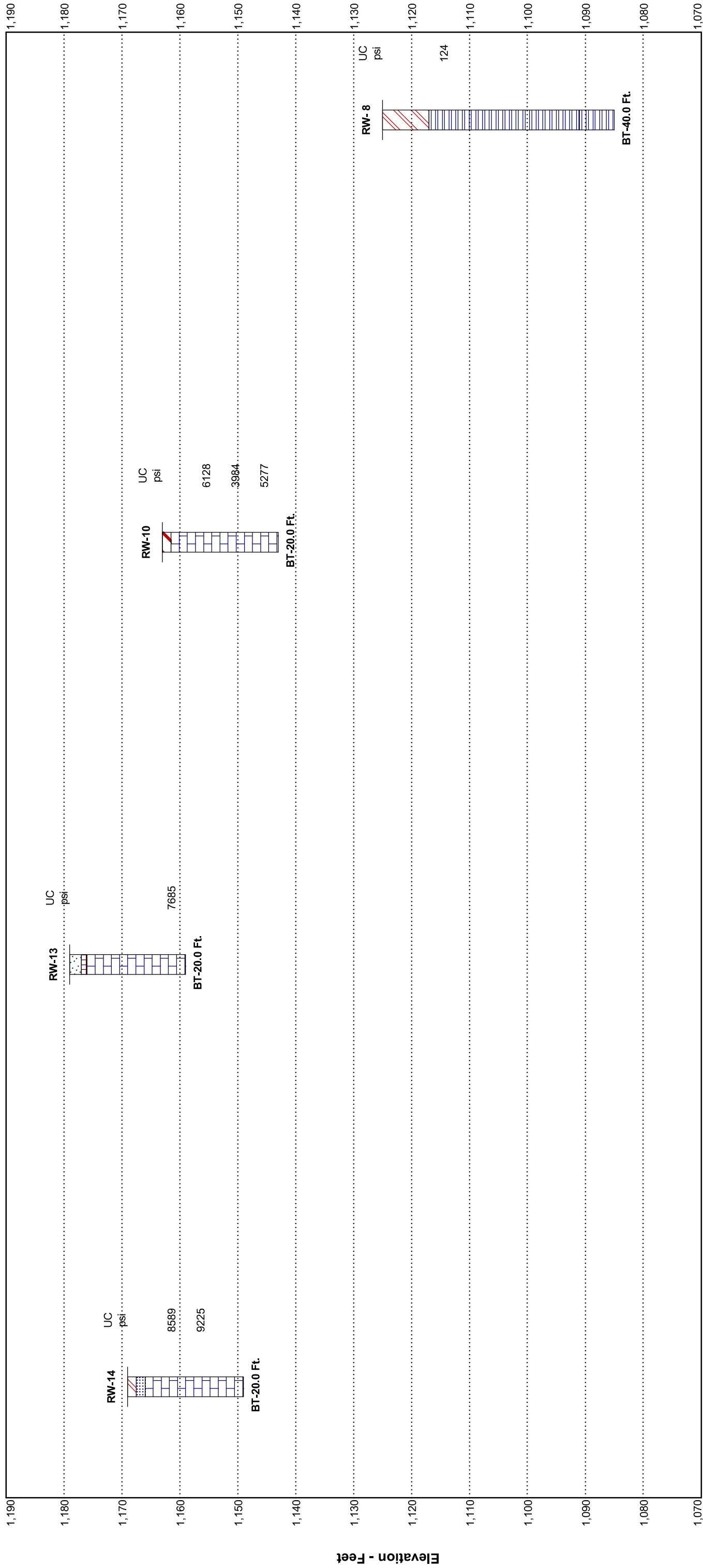
TXDOT SANDSTONE TXDOT CH TXDOT LIMESTONE TXDOT CL

Explanation

NOTES:
See Exhibit A-2 for orientation of soil profile.
See General Notes in Appendix C for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination







Project Manager: Ali	Project No.: 94175276
Drawn by: AA	Scale: N.T.S.
Approved by:	File Name: 94175276
Date: 8/14/2020	

	PH.	FAX.
	<p>SUBSURFACE PROFILE</p> <p>PALO PINTO MOUNTAINS STATE PARK FM 2372 STRAWN, TX</p>	
EXHIBIT		
A-3		



Explanation

RW-8 — Borehole Number
 — %w — Moisture Content
 — LL PL — Liquid and Plastic Limits
 — Borehole — Lithology
 — Sampling (See General Notes)

TXDOT NON-STANDARD SANDSTONE	TXDOT CL	TXDOT SHALE	TXDOT CH	TXDOT LIMESTONE	TXDOT SAND
					

NOTES:

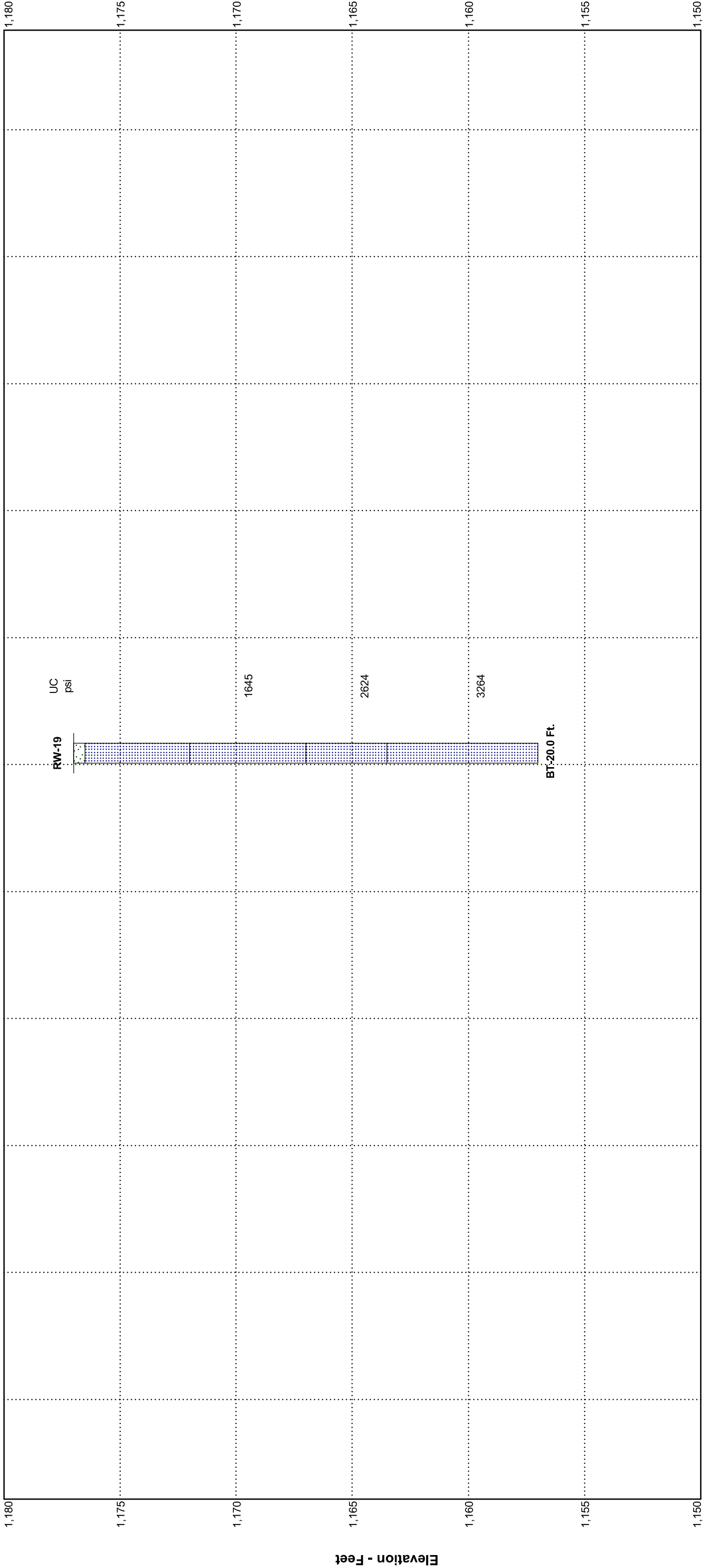
See Exhibit A-2 for orientation of soil profile.
See General Notes in Appendix C for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project Manager: Ali	Project No.: 94175276
Drawn by: AA	Scale: N.T.S.
Approved by:	File Name: 94175276
Date: 8/14/2020	

PH. FAX.

SUBSURFACE PROFILE

PALO PINTO MOUNTAINS STATE PARK
FM 2372
STRAWN, TX



Explanation

Moisture Content — %w
Sampling —
(See General Notes)

RW-19 — Borehole Number
LL PL — Liquid and Plastic Limits
AR — Borehole Lithology
BT — Borehole Termination Type

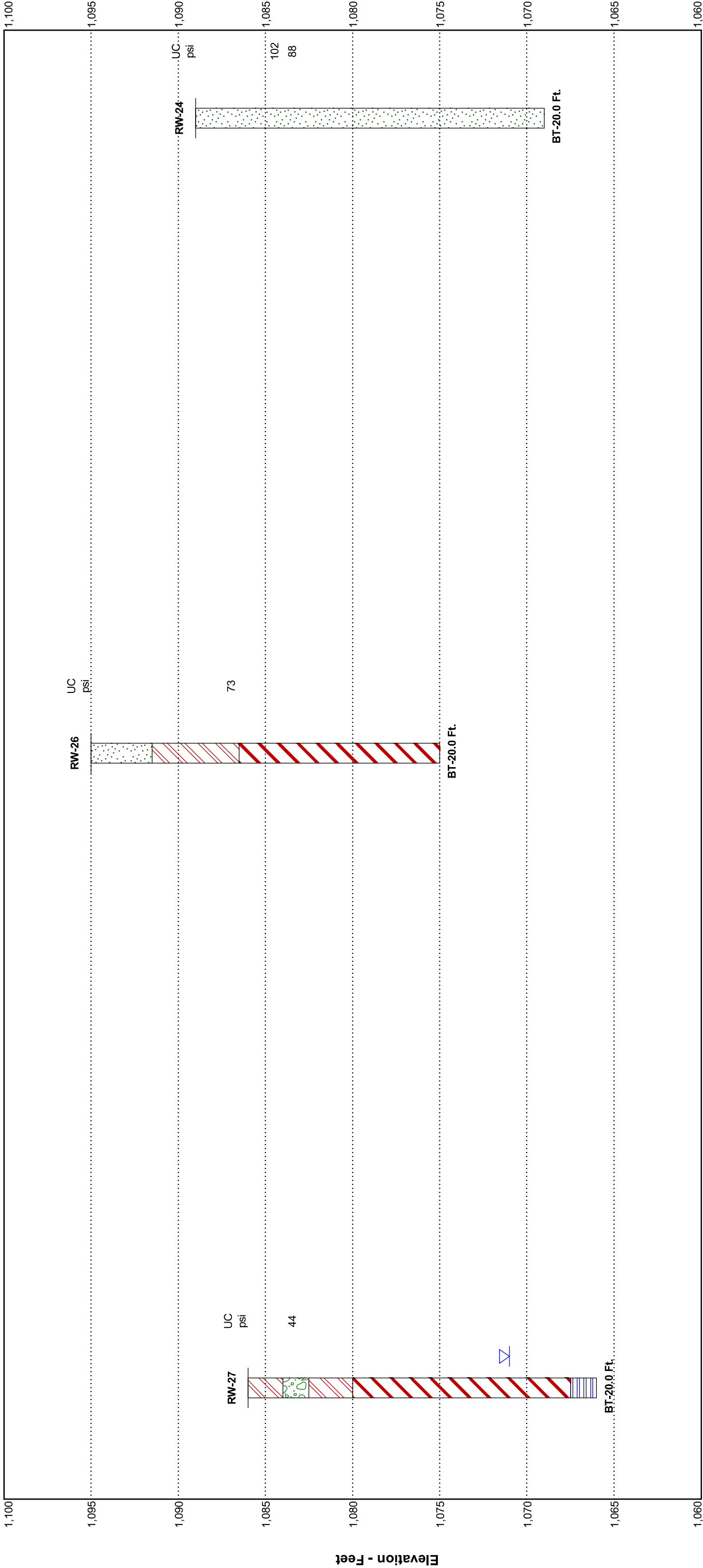
Water Level Reading at time of drilling.
Water Level Reading after drilling.

NOTES:
See Exhibit A-2 for orientation of soil profile.
See General Notes in Appendix C for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project Manager: Ali
Drawn by: AA
Approved by:
Date: 8/14/2020

PH. FAX.

SUBSURFACE PROFILE	
PALO PINTO MOUNTAINS STATE PARK FM 2372 STRAWN, TX	
EXHIBIT	
A-5	



Explanation

Moisture Content — %w

Sampling — (See General Notes)

AR — Borehole at time of drilling.

BT — Borehole after drilling.

LL — Liquid Limit

PL — Plastic Limit

Lithology — Borehole

Termination Type — Borehole

NOTES:

See Exhibit A-2 for orientation of soil profile.

See General Notes in Appendix C for symbols and soil classifications.

Soils profile provided for illustration purposes only.

AR - Auger Refusal

BT - Boring Termination

Project Manager: Ali

Drawn by: AA

Approved by:

Date: 8/14/2020

Project No.: 94175276

Scale: N.T.S.

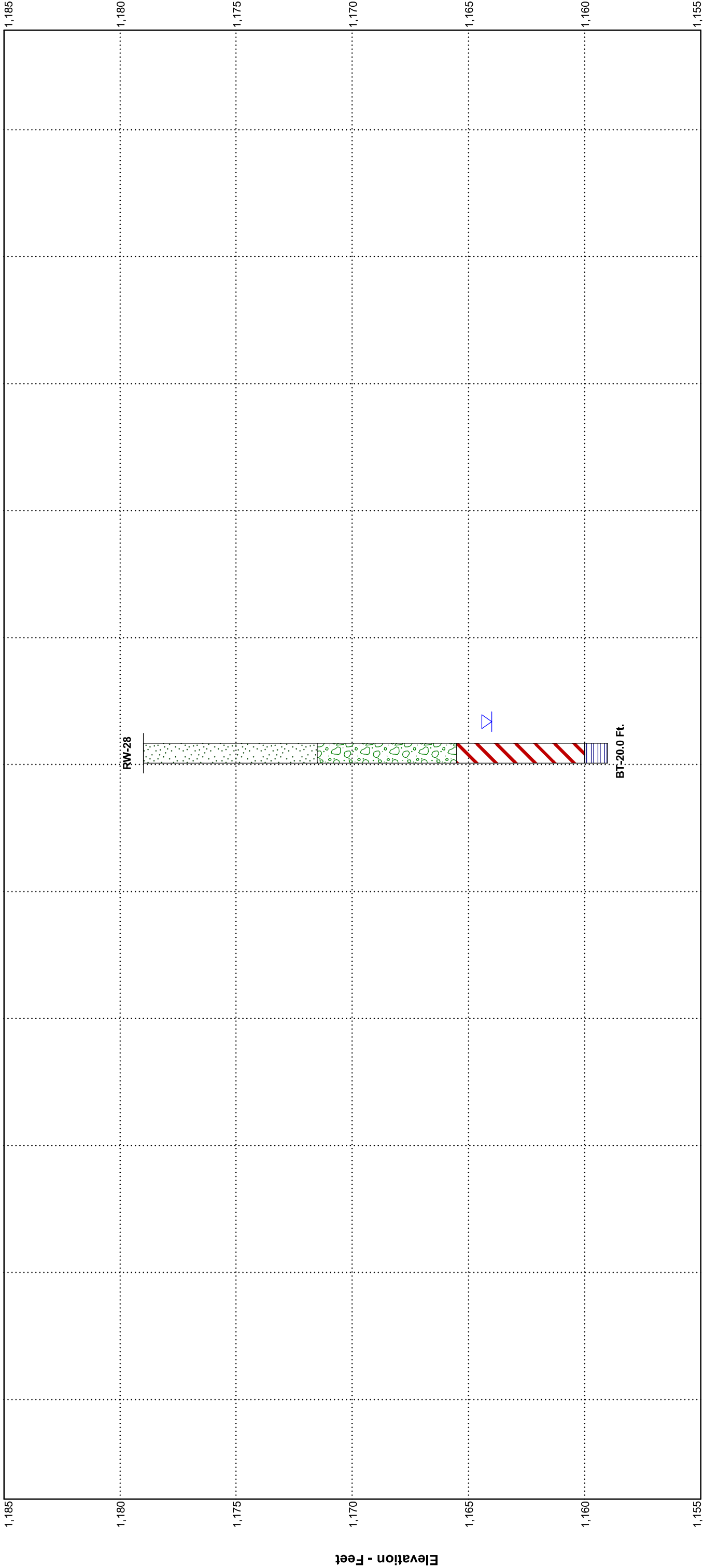
File Name: 94175276

PH. FAX.

SUBSURFACE PROFILE

PALO PINTO MOUNTAINS STATE PARK
FM 2372
STRAWN, TX

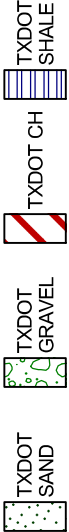
A-6



Explanation

Moisture Content — %w ☒ RW-28 — Borehole Number
Sampling — ☐ LL PL — Liquid and Plastic Limits
(See General Notes) ☐ AR — Borehole Lithology
☐ BT — Borehole Termination Type
Water Level Reading at time of drilling. ☒
Water Level Reading after drilling. ☒

NOTES:
See Exhibit A-2 for orientation of soil profile.
See General Notes in Appendix C for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Solts between borings may differ
AR - Auger Refusal
BT - Boring Termination



Project No.: 94175276

Scale: N.T.S.

File Name: 94175276

Date: 8/14/2020

Project Manager: Ali

Drawn by: AA

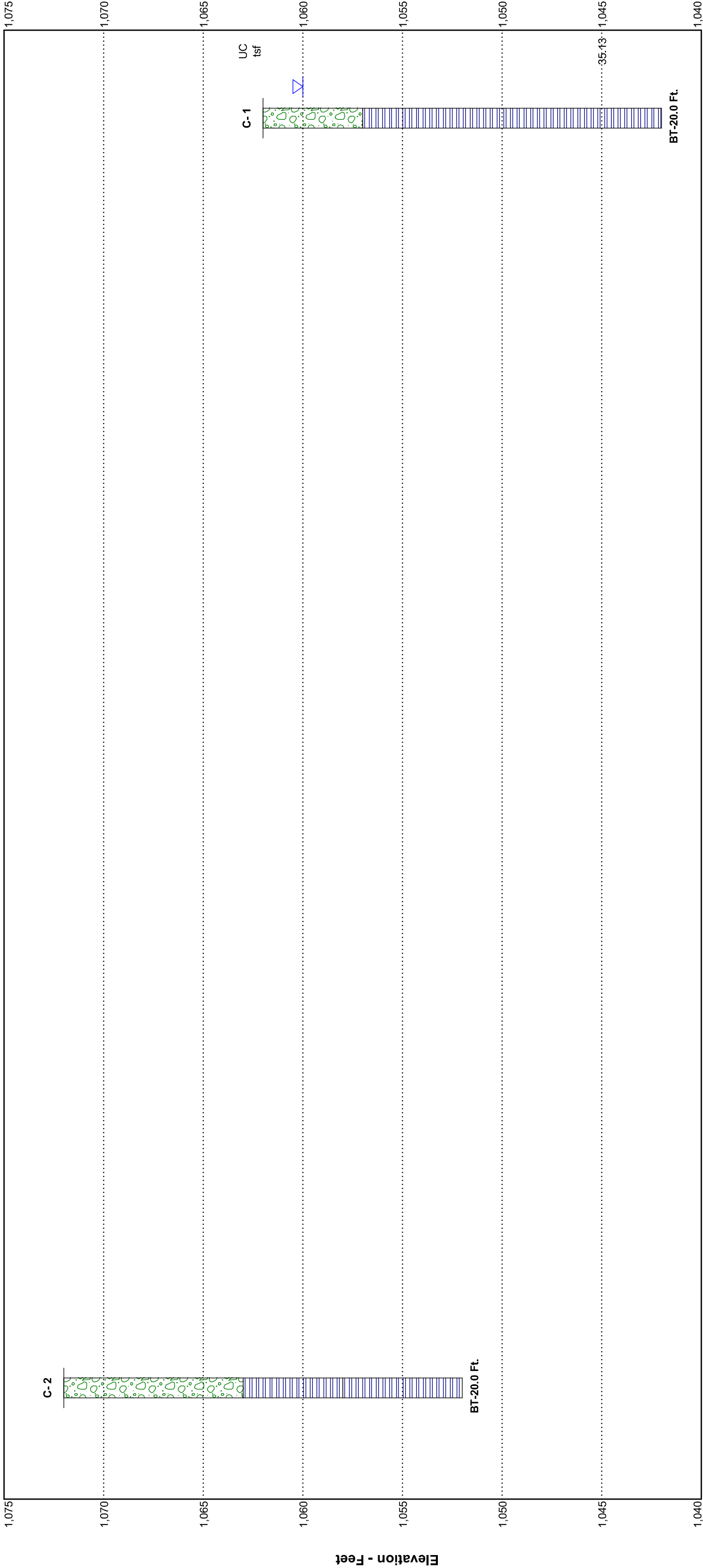
Approved by:

SUBSURFACE PROFILE

PALO PINTO MOUNTAINS STATE PARK
FM 2372
STRAWN, TX

PH. FAX.

EXHIBIT
A-7



Explanation

Moisture Content — %w ☒ C-1 Borehole Number
LL PL — Liquid and Plastic Limits
Sampling — ☐ ☐ Borehole
(See General Notes) AR BT — Termination Type
Water Level Reading at time of drilling. ☐ Borehole
Water Level Reading after drilling. ☐ Borehole

NOTES:

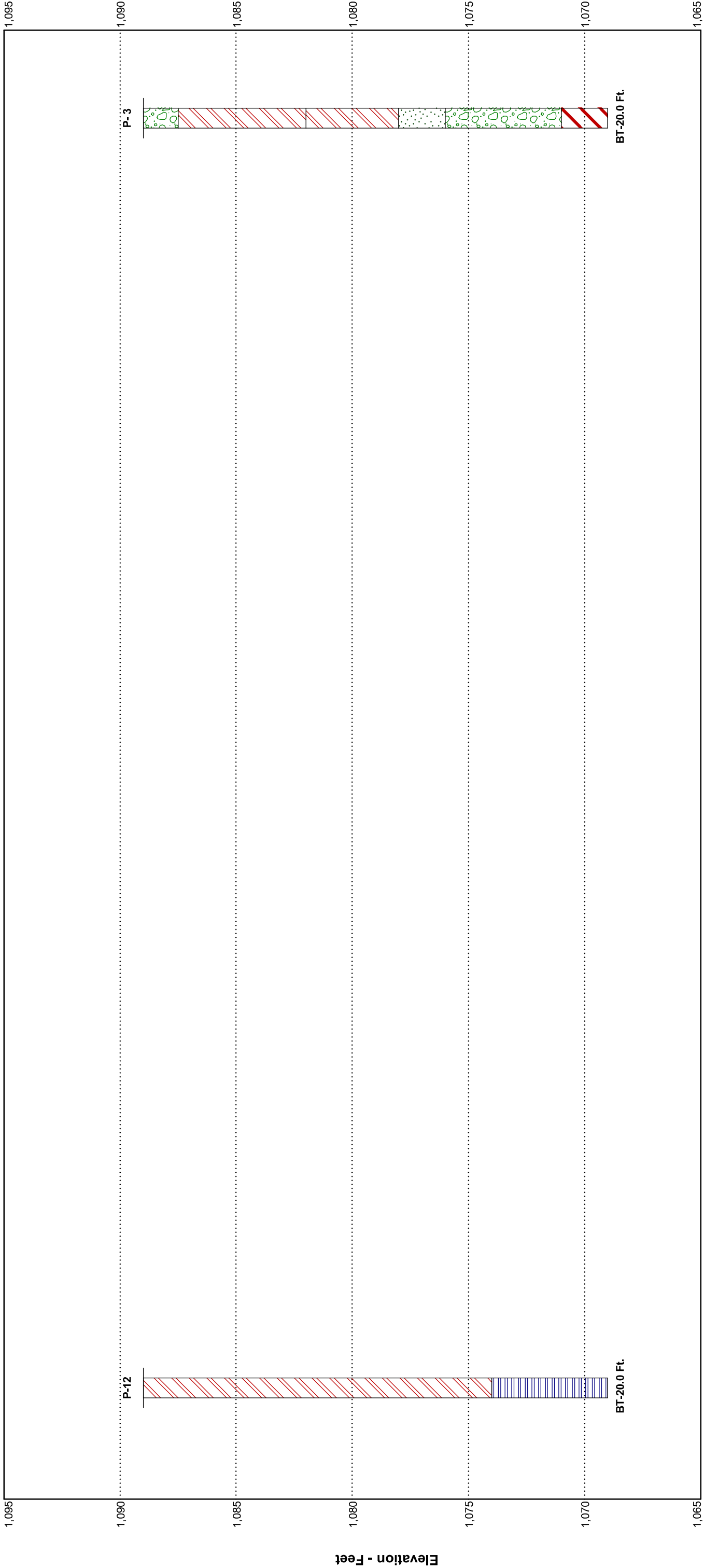
See Exhibit A-2 for orientation of soil profile.
See General Notes in Appendix C for symbols and soil classifications.
Soils profile provided for illustration purposes only.
AR - Auger Refusal
BT - Boring Termination



Project Manager: Ali	Project No.: 94175276
Drawn by: AA	Scale: N.T.S.
Approved by:	File Name: 94175276
Date: 8/14/2020	

SUBSURFACE PROFILE	
PALO PINTO MOUNTAINS STATE PARK FM 2372 STRAWN, TX	

EXHIBIT	A-8
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Explanation

Moisture Content — %w — ☒ P-3 — Borehole Number

Sampling — ☒ LL PL — Liquid and Plastic Limits

(See General Notes)

AR — Borehole

BT — Borehole

Water Level Reading at time of drilling. ☒

Water Level Reading after drilling. ☒

NOTES:

See Exhibit A-2 for orientation of soil profile.

See General Notes in Appendix C for symbols and soil classifications.

Soils profile provided for illustration purposes only.

AR - Auger Refusal

BT - Boring Termination



Project Manager: Ali	Project No.: 94175276
Drawn by: AA	Scale: N.T.S.
Approved by:	File Name: 94175276
Date: 8/14/2020	

PH.

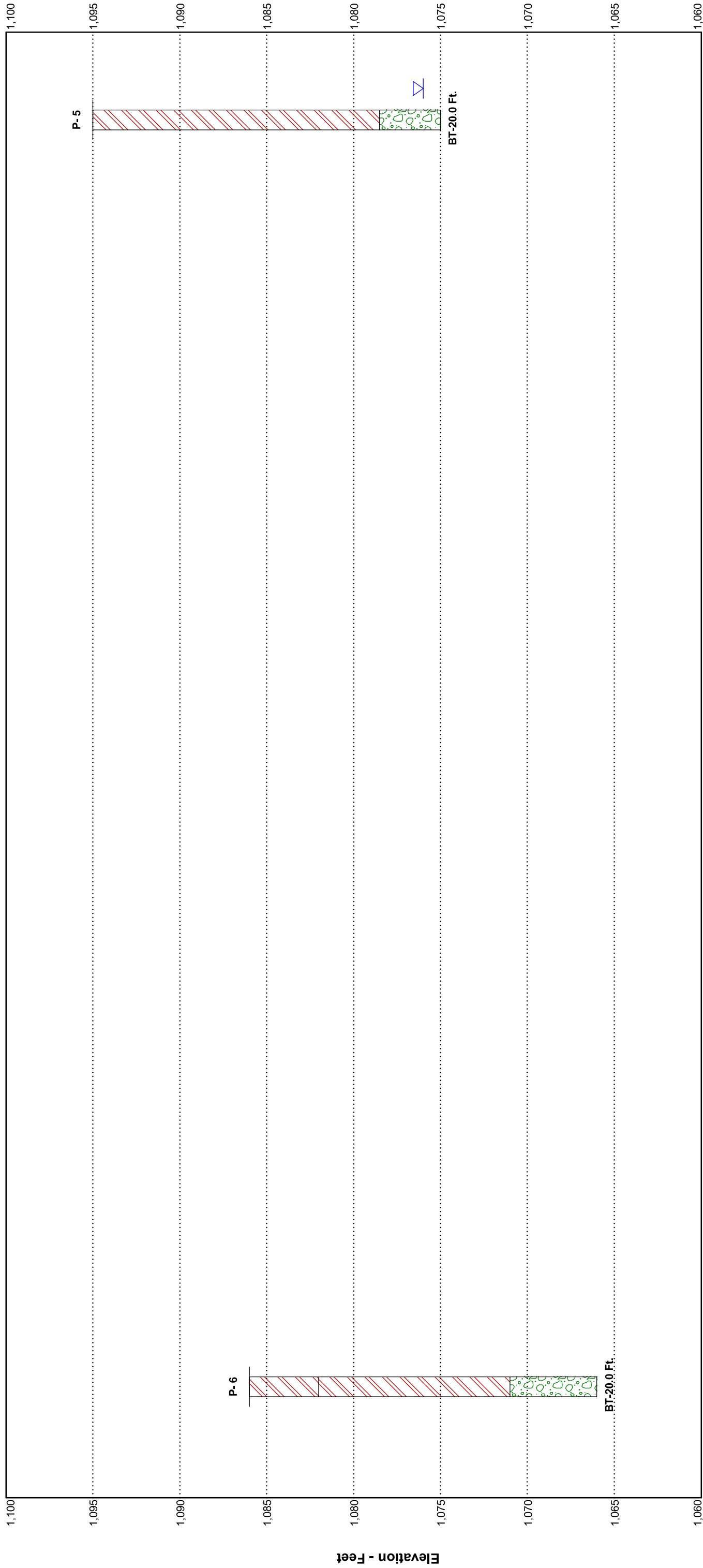
FAX.

SUBSURFACE PROFILE

PALO PINTO MOUNTAINS STATE PARK
FM 2372
STRAWN, TX

EXHIBIT

A-10



Explanation

Moisture — %w — ☐ ☒ — Liquid and Plastic Limits

Sampling
(See General Notes)

AR — Borehole
BT — Termination Type

Water Level Reading
at time of drilling.

Water Level Reading
after drilling.

NOTES:

See Exhibit A-2 for orientation of soil profile.
See General Notes in Appendix C for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

TXDOT CL
TXDOT GRAVEL

Terracon

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FAX:

SUBSURFACE PROFILE










PALO PINTO MOUNTAINS STATE PARK
FM 2372
STRAWN, TX

EXHIBIT

A-11

APPENDIX B

GENERAL NOTES

SAMPLING	WATER LEVEL	FIELD TESTS
 Auger Cuttings  Rock Core  Shelby Tube  Split Spoon  Texas Cone Penetrometer	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p>	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A					Soil Classification	
					Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above “A”	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below “A” line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line	CH	Fat clay ^{K, L, M}	
			PI plots below “A” line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

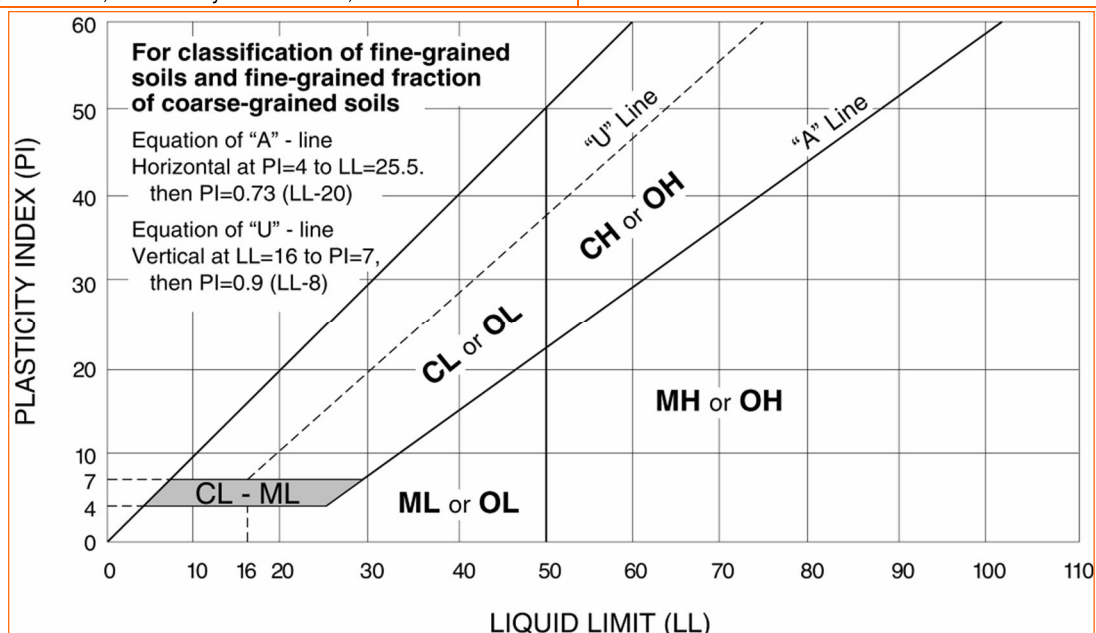
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N PI ≥ 4 and plots on or above "A" line.

^O PI < 4 or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	Description
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	Field Identification	Uniaxial Compressive Strength, psi (MPa)
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		Bedding Spacing (May Include Foliation or Banding)	
Description	Spacing	Description	Spacing
Extremely close	< ¾ in (<19 mm)	Laminated	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	Very thin	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	Thin	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	Medium	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	Thick	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	Massive	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) ¹	
Description	RQD Value (%)
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009
Technical Manual for Design and Construction of Road Tunnels – Civil Elements

DOCUMENT 00 31 32.16 – MATERIAL TESTING INFORMATION

1.1 MATERIAL TESTING INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Soil testing services were requested to obtain a Sustainable Sites Initiative (SITES) Certification. Soil-testing data for Project, obtained by Terracon Consultants, Inc., dated 5 August 2020, is appended to this Document.

END OF DOCUMENT 00 31 32.16

Soil Testing Services

Palo Pinto Mountains State Park – SITES Certification
1915 FM 2372
Strawn, Texas 76475

August 5, 2020
Terracon Project No. 94207054



Prepared for:
Texas Parks and Wildlife Department
Austin, Texas

Prepared by:
Terracon Consultants, Inc.
Dallas, Texas
TBPG Firm No. 50058

terracon.com

Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials



August 5, 2020

Ms. Andrea Kabala
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Telephone: 512-389-8434
E-mail: Andrea.Kabala@tpwd.texas.gov

Re: Soil Testing Services - SITES Certification
Palo Pinto Mountains State Park
1915 FM 2372
Strawn, Texas 76475
Terracon Project No. 94207054

Dear Ms. Kabala:

Terracon Consultants, Inc. (Terracon) is pleased to submit our report of Soil Testing Services activities completed to date at the site referenced above. Terracon's services were completed in general accordance with our proposal (P94197925 – Revised), dated January 13, 2020. This letter report provides the results of the requested soil testing to obtain a Sustainable Sites Initiative (SITES) Certification. In order to qualify for the SITES Certification, subsequent to site development, the restored soil must meet the criteria of reference soils in organic matter, bulk density/compaction and soil chemical characteristics.

On June 9, 2020 Terracon mobilized to the site to perform in-place bulk density testing and collect the reference native soil sample for organic matter and chemical characteristics analysis. A soil sample was submitted to the Texas A&M AgriLife Extension Service Soil, Water and Forage Testing Laboratory for organic matter and soil chemical characteristics, which included pH, conductivity, and Mehlich III extraction followed by ICP analysis of nitrate-N, phosphorus, potassium, calcium, magnesium, sulfur and sodium. An additional soil sample was submitted to the Texas A&M AgriLife Soil and Crop Sciences Department for cation exchange capacity (CEC) analysis. On-site in-place bulk density testing was conducted with a nuclear density gauge in accordance with ASTM D6938. The sample location was selected by the client in a location residing in an area planned for development. Terracon's field personnel determined that the sample collection and bulk density test were performed at 32° 31' 59.88", -98° 34' 2.93".

Soil Chemical Analysis

The reference soil sample had a pH of 5.8 standard units. Conductivity was measured in the soil sample at 42 micromhos (uhmo/cm). Organic matter in the soil sample was 0.95%. Nitrate was detected at a concentration of 1 milligram per kilogram (mg/kg). Phosphorus (11 mg/kg),

Terracon Consultants, Inc. 8901 Carpenter Freeway, Suite 100 Dallas, Texas 75247
P (214) 630 1010 F (214) 630 7070 terracon.com

Environmental



Facilities



Geotechnical



Materials

potassium (60 mg/kg), calcium (442 mg/kg), magnesium (58 mg/kg), sulfur (6 mg/kg), and sodium (6 mg/kg) were detected in the soil sample. CEC was measured in the soil sample at 3.9 milliequivalents per 100 grams (meq/100g).

Soil Physical Analysis

Bulk density and percent moisture testing were conducted at depths of 4 inches, 6 inches, and 8 inches below grade surface (bgs). The density and percent moisture at a depth of 4 inches bgs was 89.0 pounds per cubic foot (lbs/ft³) and 2.2%, respectively. The density and percent moisture at a depth of 6 inches bgs was 92.1 lbs/ft³ and 2.1%, respectively. The density and percent moisture at a depth of 8 inches bgs was 97.5 lbs/ft³ and 1.8%, respectively. The average density was approximately 92.9 lbs/ft³ or 1.49 grams per cubic centimeter (g/cm³). The average percent moisture in the reference soils was 2.0%.

Conclusions

Terracon understands that the SITES Certification requires an additional soil testing event for comparison purposes after development and site restoration is completed. It is Terracon's understanding that the client will notify Terracon to initiate the completion of our soil testing services after development and restoration activities have been completed. Terracon will amend this report with the addition of the restored soil sample data once received.

Standard of Care

Terracon's services were performed in a manner consistent with generally accepted practices of the profession undertaken in similar studies in the same geographical area during the same time. Terracon makes no warranties, express or implied, regarding the findings, conclusions, or recommendations. Terracon does not warrant the work of laboratories, regulatory agencies, or other third parties supplying information used in the preparation of the report. Findings, conclusions, and recommendations resulting from these services are based upon information derived from the on-site activities and other services performed under this scope of work; such information is subject to change over time. The data, interpretations, findings, and our recommendations are based solely upon data obtained at the time and within the scope of these services.

Reliance

This report has been prepared for the exclusive use of Texas Parks and Wildlife Department (the Client), and any authorization for use or reliance by any other party (except a governmental entity having jurisdiction over the site) is prohibited without the express written authorization of the Client and Terracon. Any unauthorized distribution or reuse is at the Client's sole risk.

Terracon appreciates this opportunity to provide environmental consulting services to Texas Parks and Wildlife Department. Should you have any questions or require additional information, please do not hesitate to contact our office.

Sincerely,
Terracon Consultants, Inc.

Sarah Sokol
Field Geologist

Michael Nibert, CHMM, C.E.M.
Group Manager

Attachments: Table 1 – Soil Chemical Analysis Results Summary
Table 2 – Soil Physical Analysis Results Summary
Analytical Report and Chain-of-Custody

Table 1
Soil Chemical Analysis Results Summary
Palo Pinto Mountains State Park - SITES
Strawn, Texas
Project No. 94207054

Parameter	Sample Identifier	
	558509	60920
	TAMU - SWFTL	TAMU - SCL
	6/9/2020	6/9/2020
pH (standard units)	5.8	---
Conductivity (umho/cm)	42	---
Nitrate-N (ppm)	1	---
Phosphorus (ppm)	11	---
Calcium (ppm)	60442	---
Magnesium (ppm)	58	---
Sulfur (ppm)	6	---
Sodium (ppm)	6	---
Organic Matter (%)	0.95	---
Cation Exchange Capacity (Meq/100g)	---	3.9

Notes

--- = Not analyzed

TAMU - SWFTL - Texas A&M University Soil, Water and Forage Testing Laboratory

TAMU - SCL - Texas A&M University Soil Characterization Laboratory

Table 2
Soil Physical Analysis Results
Palo Pinto Mountains State Park - SITES
Dallas, Texas
Project No. 94207054

Depth (in)	Percent Moisture	Density (lbs/ft ³)	Density (g/cm ³)
4	2.2%	89.0	1.43
6	2.1%	92.1	1.48
8	1.8%	97.5	1.56
Average	2.0%	92.9	1.49

Notes

Density and percent moisture values obtained with a nuclear density gauge in accordance with ASTM D6938



Report generated for:
 Terracon Consultants, Inc.
 Sarah Sokol
 8901 Carpenter Freeway, Ste. 100
 DALLAS, TX 75247

Palo Pinto County

Laboratory Number: 558509

Customer Sample ID: Ref-060920

Crop Grown: NO CROP GIVEN

Soil Analysis Report

Soil, Water and Forage Testing Laboratory
 Department of Soil and Crop Sciences
 2478 TAMU

College Station, TX 77843-2478

979-845-4816 (phone)

979-845-5958 (FAX)

Visit our website: <http://soiltesting.tamu.edu>

Sample received on: 6/11/2020

Printed on: 6/18/2020

Area Represented: not provided

Analysis	Results	CL*	Units	ExLow	VLow	Low	Mod	High	VHigh	Excess.
pH	5.8	(5.8)	-	Mod. Acid						
Conductivity	42	(-)	umho/cm	None						
Nitrate-N	1	(-)	ppm**	CL*						
Phosphorus	11	(0)	ppm	Fertilizer Recommended						
Potassium	60	(0)	ppm							
Calcium	442	(180)	ppm							
Magnesium	58	(50)	ppm							
Sulfur	6	(13)	ppm							
Sodium	6	(-)	ppm							
Iron										
Zinc										
Manganese										
Copper										
Boron										
Limestone Requirement										
Organic Matter	0.95	%								

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
<http://soiltesting.tamu.edu/webpages/calculator.html>

SOIL SERIES:
SOIL FAMILY:
LOCATION: Terracon
Sarah Sokol

6/26/2020

LAB NO	pH (H2O)	-----NH4OAc EXTR BASES-----					KCl	EXTR NaOAc		BASE			SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
		CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP						
		-----Meq/100g-----					-----%-----			-----%-----							
E6747	1:1						3.9										

[illegible]

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous construction waste.
 - 2. Recycling nonhazardous construction waste.
 - 3. Disposing of nonhazardous construction waste.
- B. Related Requirements:
 - 1. Section 04 22 00 "Concrete Unit Masonry" for disposal requirements for concrete masonry waste.
 - 2. Section 04 43 13.13 "Anchored Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- D. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- E. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons (tonnes).
 - 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 - 5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements.
- B. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Division 1, Special Conditions.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the Work. Facilitate recycling and salvage of materials.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.3 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
- D. Paint: Seal containers and store by type.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.

END OF SECTION 01 74 19

SECTION 02 41 13 - SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of designated site construction.
 - 2. Identification of utilities.
- B. Related Sections:
 - 1. Division 01 - Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Indicate areas for demolition, removal sequence and location of salvageable items, and location and construction of temporary work.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable code for demolition work and dust control.
- B. Obtain required permits from authorities.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Conform to applicable codes when hazardous or contaminated materials are discovered.

1.4 PROJECT CONDITIONS

- A. Minimize interference with streets, walks, public right-of-ways, and adjacent facilities.
- B. If hazardous materials are discovered, notify Owner and Landscape Architect and await instructions.
- C. If materials or conditions are encountered that differ from those indicated in Contract Documents, cease work immediately, notify Landscape Architect and await instructions.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 PREPARATION

- A. Erect temporary barricades, warning devices, and controls.
- B. Temporarily or permanently disconnect utilities as required.

3.2 DEMOLITION

- A. Remove existing construction to extent indicated and as necessary to join new work to existing. Do not remove more than is necessary to allow for new construction.
- B. Do not damage work designated to remain.

- C. Minimize noise and spread of dirt and dust.
- D. Assign work to trades skilled in procedures involved.
- E. Plug ends of disconnected utilities with threaded or welded caps.
- F. Protect and support active utilities designated to remain. Post warning signs showing location and type of utility and type of hazard.
- G. Store items designated to remain property of Owner where directed by Owner.
- H. Remove and dispose of waste materials off site.

END OF SECTION 02 41 13

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete reinforcement, for the following:
 - 1. Footings and/or piers.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building frame members.
 - 7. Building walls.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 10 00 "Concrete Forming and Accessories".
 - 3. Section 03 30 00 "Cast In Place Concrete".
 - 4. Section 03 47 13 "Tilt Up Concrete".
 - 5. Section 03 38 16 "Unbonded Post Tensioned Concrete".
 - 6. Section 04 22 00 "Concrete Unit Masonry".
 - 7. Section 31 20 00 "Earth Moving".
 - 8. Section 31 63 29 "Drilled Concrete Piers".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. American Concrete Institute (ACI)
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
 - b. ACI 301 – Specifications for Structural Concrete for Buildings
 - c. ACI 315 – Details and Detailing of Concrete Reinforcement
 - d. SP-66 ACI Detailing Manual
 - 2. American Welding Society (AWS)
 - a. AWS D1.1 – Structural Welding Code
 - 3. Concrete Reinforcing Steel Institute (CRSI)
 - a. CRSI – Manual of Standard Practice
 - b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars
 - c. CRSI 65 – Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
- B. American Society of Testing Materials (ASTM)
 - a. ASTM-A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
 - b. ASTM-A663: Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
 - c. ASTM-A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

- d. ASTM-A675: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
 - e. ASTM-A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - f. ASTM-A775: Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - g. ASTM-A884: Standard Specification for Epoxy-Coated Wire and Welded Wire Reinforcement.
- C. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement, according to ACI 315 "Details and Detailing of Concrete Reinforcement."
 - 1. Do not reproduce the structural drawings for use as shop drawings.
- D. Bar Supports: Submit manufacturer's product information for bolsters, chairs, spaces, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, installer, and fabricator as indicated herein.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Steel reinforcement and accessories.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Installer Qualifications: An experienced installer who has completed reinforcing installation work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.
- C. Fabricator Qualifications: An experienced fabricator who has completed reinforcing fabrication work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- E. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60.
- C. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- D. Plain-Steel Wire: ASTM A 82, as drawn .
- E. Deformed-Steel Wire: ASTM A 496.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." Combined tolerances for formwork, reinforcing fabrication, and reinforcing placement shall not permit a reduction in specified concrete cover of reinforcing steel. In case of fabricating errors, do not re-bend or straighten

reinforcement in a manner that will injure or weaken material. Bars used for concrete reinforcement shall meet following requirements for fabricating tolerances:

1. Sheared length: Plus or minus 1 inch.
2. Depth of truss bars: Plus 0, minus ½ inch.
3. Overall dimensions of stirrups, ties, and spirals: Plus or minus ½ inch.
4. Other bends: Plus or minus 1 inch.

- B. For bars with end bearing splice couplers, bar ends shall terminate in flat surfaces, within 1.5 degrees of a right angle to axis of bars and shall be fitted within 3 degrees of full bearing after assembly.

2.4 DOWEL BAR ANCHORS/SPLICERS

- A. A. Provide dowel bar anchors and threaded dowels designed to develop, both in tension and compression, 125% of the minimum ASTM specified yield strength of the dowel bars, as evidenced by published I.C.B.O. test reports. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by anchor supplier. The following dowel splicing systems are acceptable.
1. Richmond Screw Anchor "Dowel Bar Splicer"
 2. Erico "Lenton Form Saver"
 3. Dayton Barsplice "Grip-Twist"

2.5 MECHANICAL SPLICES

- A. A. Provide mechanical splices designed to develop, both in tension and compression, 125% of minimum ASTM yield strength of the smaller bar being coupled, as evidenced by published I.C.B.O test reports. The following bar splicing systems are acceptable.
1. Erico "Cadweld C-Series"
 2. Erico "Lenton"
 3. Dayton Barsplice "Bar Grip"
 4. Dayton Barsplice "Grip Twist"

2.6 METAL ANCHORAGE AND EMBEDDED METAL ASSEMBLIES

- A. Steel Shapes and Plates: Conform to ASTM A36, "Specification for Structural Steel".
- B. Headed Stud Anchors: Headed studs welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- C. Welding Electrodes: AWS 5.5, Series E70.
- D. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- E. All metal assemblies exposed to earth, weather or moisture, including exposure to a crawl space environment, shall be hot dip galvanized.

2.7 FABRICATION OF METAL ACCESSORIES AND EMBEDDED METAL ASSEMBLIES

- A. Fabricate and assemble structural steel items in the shop. Shearing, flame cutting, and chipping shall be done carefully and accurately. Holes shall be cut, drilled, or punched at right angles to the surface of metal and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges. Welded construction shall conform to AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and AWS D1.1. Welding shall be done by AWS certified welders.

- B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division of KSM Welding Services Division, Omark, Ind. A minimum of two headed studs shall be tested at start of each production period for proper quality control. Studs shall be capable of being bent 45 degrees without weld failure.
- C. Welding of reinforcement shall be done in strict accordance with AWS requirements, using recommended preheat temperature and electrode for type of reinforcement being welded. Bars larger than No. 9 shall not be welded. Welding shall be performed subject to the observance and testing laboratory. Under no circumstances is ordinary reinforcing (ASTM A615) to be welded.
- D. Coatings, where required, shall be applied after fabrication and prior to casting concrete.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Provide minimum concrete covering for reinforcement as shown in the Structural General Notes.
- G. Place bars to following tolerances:
 - 1. Clear distance to formed surfaces: Plus or minus ¼ inch.
 - 2. Minimum spacing between bars: Minus ¼ inch.
 - 3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: Plus or minus ¼ inch.
 - b. Members between 8 and 24 inches deep: Plus or minus ½ inch.
 - c. Members more than 24 inches deep: Plus or minus 1 inch.
 - 4. Crosswise of members: Spaced evenly within 2 inches.
 - 5. Length of members: Plus or minus 2 inches.

- H. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter, or enough to exceed above tolerances, resulting arrangement of bars subject to approval.
- I. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.
- J. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

3.3 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 30 00**CAST-IN-PLACE CONCRETE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Foundation walls.
 - 2. Slabs-on-grade.
 - 3. Suspended slabs.
 - 4. Concrete toppings.
 - 5. Building frame members.
 - 6. Building walls.
- B. Related Sections:
 - 1. Section 01 45 23 "Structural Testing and Inspection Services".
 - 2. Section 03 20 00 "Concrete Forming and Accessories".
 - 3. Section 03 10 00 "Concrete Reinforcing".
 - 4. Section 03 11 31 "Void Forms".
 - 5. Section 03 15 13 "Waterstops".
 - 6. Section 03 05 80 "Under-slab Vapor Barrier – Retarder".
 - 7. Section 03 47 13 "Tilt Up Concrete".
 - 8. Section 31 63 29 "Drilled Concrete Piers and Shafts".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. ACI 301 – Specification for Structural Concrete.
 - 2. ACI 302 – Guide for Concrete Floor Slab Construction.
 - 3. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 4. ACI 305 – Hot Weather Concreting.
 - 5. ACI 306 – Cold Weather Concreting.
 - 6. ACI 308 – Guide to Curing Concrete.
 - 7. ACI 309 – Guide for Consolidating Concrete.
 - 8. ACI 311 – ACI Manual for Concrete Inspection.
 - 9. ACI 318 – Building Code Requirements for Reinforced Concrete.
 - 10. ACI 347 – Guide to Concrete Formwork.
 - 11. ACI 207 – Mass Concrete.
 - 12. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 13. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
 - 14. ACI 212.3 – Chemical Admixture for Concrete.
 - 15. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
 - 16. ACI 214 – Evaluation of Strength Test Results of Concrete.
 - 17. ACI 303 – Guide to Cast in Place Architectural Concrete Practice.
 - 18. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.3: For liquid floor treatments and curing and sealing compounds, documentation including printed statement of VOC content.
 - 3. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements, and for equivalent concrete mixtures that do not contain Portland cement replacements.
- C. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
 - 2. Proportions of cement, fine, and coarse aggregate, and water.
 - 3. Design strength.
 - 4. Maximum slump.
 - 5. Air Content.
 - 6. Maximum water / cement ratio.
 - 7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
 - 8. Type cement and aggregates.
 - 9. Type and quantities of all admixtures.
 - 10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
 - 11. Type, color, and quantities of integral coloring compounds, where applicable.
 - 12. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Steel Reinforcement Shop Drawings: Refer Section 03 20 00.
- E. Formwork Shop Drawings: Refer Section 03 10 00.
- F. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.

- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Fiber reinforcement.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Semi rigid joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: See Section 01 45 23.
 - 1. Contractor's responsibility to testing laboratory.
 - a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
 - b. Advise the Owner's Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.
 - c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.
- H. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. See Section 03 10 00.

2.2 STEEL REINFORCEMENT

- A. See Section 03 20 00.

2.3 REINFORCEMENT ACCESSORIES

- A. See Section 03 20 00.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 1. Maximum Coarse-Aggregate Size: 1-1/2 inches, 1 inch, or 3/4 inch nominal as indicated on Drawings for specific uses.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94 and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ChemMasters.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Hoover Color Corporation.
 - e. Lambert Corporation.
 - f. QC Construction Products.
 - g. Rockwood Pigments NA, Inc.
 - h. Scofield, L. M. Company.
 - i. Solomon Colors, Inc.
 - 2. Color: As selected by Architect from manufacturer's full range.

2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1 to 2-1/4 inches long.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 3M; Scotchcast Polyolefin Fibers 2".
 - b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
 - c. FORTA Corporation; FORTA FERRO.
 - d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
 - e. Nycon, Inc.; XL.
 - f. Propex Concrete Systems Corp.; Fibermesh 650.
 - g. Sika Corporation; Sika Fiber MS or MS10.

2.7 CONCRETE MIX DESIGNS

- A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.
- B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength f'_c by the amount defined in ACI 301.

2.8 VAPOR RETARDERS

- A. See Section 03 05 80.

2.9 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; Emery.
 - b. Dayton Superior Corporation; Emery Tuff Non-Slip.
 - c. Lambert Corporation; EMAG-20.
 - d. L&M Construction Chemicals, Inc.; Grip It.
 - e. Metalcrete Industries; Metco Anti-Skid Aggregate.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; A-H Alox.
 - b. BASF Construction Chemicals - Building Systems; Frictex NS.
 - c. L&M Construction Chemicals, Inc.; Grip It AO.

2.10 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemMasters; Chemisil Plus.
 - b. ChemTec Int'l; ChemTec One.
 - c. Conspec by Dayton Superior; Intraseal.
 - d. Curecrete Distribution Inc.; Ashford Formula.
 - e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - f. Edoco by Dayton Superior; Titan Hard.
 - g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
 - h. Kaufman Products, Inc.; SureHard.
 - i. L&M Construction Chemicals, Inc.; Seal Hard.
 - j. Meadows, W. R., Inc.; LIQUI-HARD.
 - k. Metalcrete Industries; Floorsaver.
 - l. Nox-Crete Products Group; Duro-Nox.
 - m. Symons by Dayton Superior; Buff Hard.
 - n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
 - o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
- C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Floor Products; Retro-Plate 99.
 - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.11 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.
 - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; AQUA KURE - CLEAR.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100-CLEAR.
 - l. Nox-Crete Products Group; Resin Cure E.
 - m. Right Pointe; Clear Water Resin.
 - n. SpecChem, LLC; Spec Rez Clear.
 - o. Symons by Dayton Superior; Resi-Chem Clear.
 - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - g. Lambert Corporation; UV Safe Seal.
 - h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - i. Meadows, W. R., Inc.; Vocomp-30.
 - j. Metalcrete Industries; Metcure 30.
 - k. Right Pointe; Right Sheen WB30.

- I. Symons by Dayton Superior; Cure & Seal 31 Percent E.
 - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
- 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.12 RELATED MATERIALS

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.

- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 NON-SHRINK GROUT

- A. Grout shall be prepackaged, non metallic, and non gaseous. It shall be non-shrink when tested in accordance with ASTM-C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in temperatures of 40 degrees to 90 degrees Fahrenheit. Grout shall be bleed free and attain 7,500 psi compressive strength in 28 days at fluid consistency. Certified independent test data required. Approved products include the following:
 - 1. "Euco NS" by Euclid Chemical Company
 - 2. "Masterflow 713" by Master Builders.

2.16 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion normal-weight concrete mixture as indicated in Structural General Notes:

2.17 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. See Section 03 10 00.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. See Section 03 10 00.

3.4 SHORES AND RESHORES

- A. See Section 03 10 00.

3.5 VAPOR RETARDERS/BARRIERS

- A. See Section 03 05 80.

3.6 STEEL REINFORCEMENT

- A. See Section 03 20 00

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are specified or otherwise indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Do not permit concrete to drop freely any distance greater than 10'-0" for concrete containing a high range water reducing admixture or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

H. Hot-Weather Placement: Comply with ACI 305 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. See Section 03 10 00.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and/or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated and/or to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and/or exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces according to ASTM E 1155, for a randomly trafficked floor surface.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 2. After broadcasting and tamping, apply float finish.
 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive granules.

3.11 Concrete Floor Finish Tolerances

- A. Interior Finish Floor surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." The following values apply before removal of shores. Levelness values F(L) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
 - 1. Exposed, vinyl tiled, or thin-set tiled floors: Specified overall values of flatness, Ff =35; and levelness, FI =25; with minimum local values of flatness, Ff =24; and levelness, FI =17.
 - 2. Carpeted floors, floors under concrete toppings, thickset tile and terrazzo: Specified overall values of flatness, Ff =25; and levelness, FI = 20; with minimum local values of flatness, Ff =17; and levelness, FI =15.
- B. Floor Elevation Tolerance Envelope:
 - 1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
 - a. Slab-on-Grade, or Slab-on-Void Construction: +/- 3/4"
 - b. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
 - c. Top surfaces of all other slabs: +/- 3/4"
 - d. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

- a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturers written instructions.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than 28 days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
 4. Control and dispose of waste products produced by grinding and polishing operations.
 5. Neutralize and clean polished floor surfaces.
- C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 - 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - 2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 30 00

SECTION 03 30 53 - LANDSCAPE CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 1. Concrete formwork.
 2. Concrete reinforcement.
 3. Cast-in-place concrete.
 4. Concrete finishing.
- B. Related Sections:
 1. Division 01: Administrative, procedural, and temporary requirements.
 2. Section 32 13 13 - Landscape Concrete Paving.

1.2 REFERENCES

- A. American Concrete Institute (ACI):
 1. 301 - Structural Concrete for Buildings.
 2. 302.1 - Guide for Concrete Floor and Slab Construction.
 3. 305R - Hot Weather Concreting.
 4. 306R - Cold Weather Concreting.
 5. 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International (ASTM):
 1. A185 - Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement.
 2. A615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 3. C33 - Standard Specification for Concrete Aggregates.
 4. C94 - Standard Specification for Ready-Mixed Concrete.
 5. C150 - Standard Specification for Portland Cement.
 6. C171 - Standard Specification for Sheet Materials for Curing Concrete.
 7. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 8. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 9. C494 - Standard Specification for Chemical Admixtures for Concrete.
 10. D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- C. Concrete Reinforcing Steel Institute (CRSI) - Manual of Practice.

1.3 SUBMITTALS

- A. Submittals for Review:
 1. Product Data: Descriptive data for color admixture and curing compound.
 2. Shop Drawings:
 - a. Include pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - b. Show means of leakage prevention for concrete exposed to view in finished construction.
 - c. Show sequence and timing of erection and stripping.
 3. Concrete Mix Designs: Submit for each type of concrete.

1.4 QUALITY ASSURANCE

- A. Concrete Mix Design: In accordance with ACI 301, Method 1 or 2.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Mix and deliver concrete to project ready mixed in accordance with ASTM C94.
- B. Schedule delivery so that pours will not be interrupted for over 15 minutes.
- C. Place concrete on site within 90 minutes after proportioning materials at batch plant.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Formwork:
 - 1. Forms: Wood, metal, or glass fiber type, tight fitting.
 - 2. Fasteners: Size as required, sufficient strength to maintain forms in place while concrete is placed.
 - 3. Form release agent: Nonstaining, colorless mineral oil that will not absorb moisture, stain concrete, or impair adhesion of coatings to be applied to concrete.
 - 4. Construction joints forms: Formed steel, with keyway.
 - 5. Form ties: Snap off type, adjustable length, 1 inch back break dimension, free of defects that could leave holes larger than 1 inch in concrete.
- B. Reinforcement:
 - 1. Bars: ASTM A615/A615M, deformed billet steel.
 - 2. Welded wire fabric: ASTM A185; furnish in flat sheets.
 - 3. Chairs, bolsters, bars supports, and spacers:
 - a. Sized and shaped for support of reinforcement during concrete placement.
 - b. Plastic coated steel for surfaces exposed to weather.
 - 4. Tie wire: Annealed steel, 16 gage minimum.
- C. Concrete Materials:
 - 1. Portland cement: ASTM C150, Type I or III as applicable.
 - 2. Aggregates: ASTM C33, clean, hard, durable, and uncoated.
 - a. Fine: Natural sand, free from silt, loam, and clay.
 - b. Coarse: Crushed stone, maximum size No. 467, Table No. 2.
 - 3. Admixtures:
 - a. Water reducing or water reducing/set retarding: ASTM C494, Type A or D.
 - b. Air entraining: ASTM C260.
- D. Expansion Joint Filler: ASTM D1752, Type 1, non asphaltic.
- E. Non Shrink Grout: Premixed, consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; 7,000 PSI compressive strength at 28 days.
- F. Curing Materials:
 - 1. Curing compound: ASTM C309, Type 1.
 - 2. Curing paper: ASTM C171, waterproof paper or polyethylene film.
- G. Bonding Agent: Two component modified epoxy resin.
- H. Water: Clean and potable.

2.2 MIXES

- A. Proportions: In accordance with ACI 301.
- B. Design concrete to yield following characteristics unless otherwise indicated:
 - 1. Minimum 28 day compressive strength: 3000 PSI.
 - 2. Slump:
 - a. Footings: 4 to 6 inches.
 - b. Other uses: 3 to 5 inches.
 - 3. Air entrainment: Provide air entraining admixture to produce 4 to 6 percent air by volume of concrete.

2.3 FABRICATION

- A. Reinforcing: In accordance with CRSI Manual.

PART 3 EXECUTION

3.1 PREPARATION

- A. Notify Owner, Landscape Architect, and Testing Laboratory minimum 24 hours prior to placing concrete.
- B. Remove water and debris from forms and excavations before concrete is deposited.
- C. Provide devices for conveying concrete to point of deposit to prevent disturbing forms or reinforcing or segregating concrete.
- D. Clean reinforcement of loose rust, mill scale, dirt, oil, and other materials that could reduce bonding.
- E. Prepare previously placed and existing concrete surfaces by cleaning with steel wire brush and applying bonding agent in accordance with manufacturer's instructions.
- F. Where new concrete is doweled to existing, drill holes in existing concrete, insert steel dowels, and pack holes solid with non shrink grout.

3.2 INSTALLATION OF FORMWORK

- A. Construct forms tight to prevent loss of mortar.
- B. Clean contact and screed surfaces of hardened concrete and foreign materials prior to assembly.
- C. Apply form release agent to contact surfaces; follow manufacturer's instructions.

3.3 INSTALLATION OF REINFORCEMENT

- A. Bar Reinforcement: In accordance with ACI 301 and CRSI Manual.
- B. Wire Fabric:
 - 1. Install in longest practical length.
 - 2. Offset end laps in adjacent widths to prevent continuous lap.

3.4 PLACEMENT OF CONCRETE

- A. Place concrete in accordance with ACI 301 and ACI 318.

- B. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.
- C. Deposit concrete as nearly as possible in its final position to minimize handling and flowing.
- D. Place concrete continuously between predetermined expansion, control, and construction joints.
- E. Do not place partially hardened, contaminated, or retempered concrete.
- F. Do not allow concrete to free fall over 8 feet; provide tremies, chutes, or other means of conveyance.
- G. Consolidate concrete with mechanical vibrating equipment. Hand compact in corners and angles of forms.
- H. Screed slabs to flatness tolerance of 1/4 inch in 10 feet.

3.5 FORM REMOVAL

- A. Remove forming materials in manner that will not damage surfaces of concrete; patch work damaged during form removal operations.
- B. Provide shoring and bracing as required.

3.6 FINISHING

- A. Concealed Formed Surfaces: Leave texture imparted by forms.
- B. Exposed Formed Surfaces:
 - 1. While concrete is still green:
 - a. Patch voids over 1/2 inch in diameter or depth.
 - b. Remove fins and other protrusions by rubbing with carborundum stone.
- C. Slabs:
 - 1. Finish surfaces in accordance with ACI 301 and ACI 302.1.
 - 2. Finish surfaces as specified in Section 32 13 13.
- D. Allowable Tolerances: In accordance with ACI 301.

3.7 PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Provide artificial heat to maintain temperature of concrete above minimum specified temperature for duration of curing period.
- D. Keep forms sufficiently wet to prevent cracking of concrete or loosening of form joints.
- E. After form removal from board formed surfaces install 3/8 inch plywood as protection for exposed surfaces. Do not mechanically attach to concrete.

3.8 CURING

- A. Cure concrete in accordance with ACI 308:
 - 1. Horizontal surfaces: Use either curing paper or curing compound method.
 - 2. Vertical surfaces: Use either wet curing or curing compound method.

3.9 CLEANING

- A. Remove efflorescence, stains, oil, grease, and foreign materials from exposed surfaces.

END OF SECTION 03 30 53

SECTION 04 05 11 - LANDSCAPE MASONRY MORTARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mortar for masonry.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 22 00 - Landscape Concrete Unit Masonry.
 - 3. Section 04 42 00 - Landscape Stone Assemblies.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 2. C150 - Standard Specification for Portland Cement.
 - 3. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 4. C270 - Standard Specification for Mortar for Unit Masonry.
- B. The Masonry Society (TMS) 402/602 - Building Code Requirements and Specifications for Masonry Structures.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Samples: 1/2 x 1/2 inch x 3 inch long colored mortar samples.
- B. Quality Control Submittals:
 - 1. Test reports: Indicating mortar compliance with ASTM C270.
 - 2. Delivery tickets: If mortar is delivered to site dry and pre-blended, furnish delivery tickets indicating quantity, mortar type, and date of manufacture.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with TMS 402/602.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver cement and lime in manufacturer's original, unopened packages or containers.
- B. Protect materials from moisture absorption and damage; reject damaged containers.
- C. Store aggregate to prevent inclusion of foreign matter.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Colorants:
 - 1. Cathay Pigments. (www.cathaypigments.com)
 - 2. Davis Colors. (www.daviscolors.com)
 - 3. Solomon Colors. (www.solomoncolors.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Portland Cement:
 - 1. ASTM C150, Type I.
 - 2. For exposed surfaces, provide cement from one source throughout project.
- B. Aggregate:
 - 1. ASTM C144, standard masonry type.
 - 2. For exposed surfaces, provide aggregate from one source throughout project.
- C. Lime: ASTM C207, Type S.
- D. Colorant: Pure mineral oxide type.
- E. Water: Clean and free from oils, acids, alkalies, organic matter, and other substances in amounts deleterious to mortar or metals in masonry.

2.3 MIXES

- A. Mortar Mixes: To ASTM C270, using the Property Method.
 - 1. Concrete unit masonry: Type S, gray.
 - 2. Stone assemblies:
 - a. Setting mortar: Type N, gray.
 - b. Pointing mortar: Type N; refer to Materials Legend for color.

2.4 MIXING

- A. Portland Cement Mortar:
 - 1. Mix mortar in accordance with ASTM C270.
 - 2. Mix using mechanical mixer. Hand mixing not permitted.
 - 3. Mix approximately three-quarters of required water, all of cement and lime, and one-half of aggregate for minimum of 2 minutes.
 - 4. Add remainder of water and aggregate; mix for minimum of 3 minutes.
 - 5. Provide uniformity of color in exposed mortar.
 - 6. Colorant may not exceed 9 pounds per 94 pound bag of cement.
 - 7. Thoroughly mix ingredients in quantities needed for immediate use.
 - 8. Discard lumpy, caked, frozen, and hardened mixes.
 - 9. Mortar may be retempered by adding water as required. Use mortar within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after initial mixing at ambient temperatures over 80 degrees F.
 - 10. Do not add accelerators, retarders, water repellents, antifreeze compounds, or other additives without Landscape Architect's approval.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Follow requirements specified in referenced sections.

END OF SECTION 04 05 11

SECTION 04 05 14 - LANDSCAPE MASONRY GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grout for masonry.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 22 00 - Landscape Concrete Unit Masonry.
 - 3. Section 04 42 00 - Landscape Stone Assemblies.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C150 - Standard Specification for Portland Cement.
 - 2. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 3. C404 - Standard Specification for Aggregates for Masonry Grout.
 - 4. C476 - Standard Specification for Mortar and Grout for Reinforced Masonry.
- B. The Masonry Society (TMS) 402/602 - Building Code Requirements and Specifications for Masonry Structures.

1.3 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Test reports: Indicating grout compliance with ASTM C476.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with TMS 402/602.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver cement and lime in manufacturer's original, unopened packages or containers.
- B. Protect materials from moisture absorption and damage; reject damaged containers.
- C. Store aggregate to prevent inclusion of foreign matter.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C150, Type I.
- B. Aggregate: ASTM C404.
- C. Lime: ASTM C207, Type S.
- D. Water: Clean and free from oils, acids, alkalis, organic matter, and other substances in amounts deleterious to mortar or metals in masonry.

2.2 MIXES

- A. Grout Mix:
 - 1. ASTM C476, coarse grout.
 - 2. Compressive strength: Minimum 2500 psi at 28 days.
 - 3. Slump: 7 to 8 inches.

2.3 MIXING

- A. Mix grout in accordance with ASTM C476.
- B. Thoroughly mix ingredients in quantities needed for immediate use.
- C. Mix dry ingredients mechanically until uniformly distributed; add water to achieve workable consistency.
- D. Discard lumpy, caked, frozen, and hardened mixes.
- E. Use grout within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after initial mixing at ambient temperatures over 80 degrees F.
- F. Do not add accelerators, retarders, water repellents, antifreeze compounds, or other additives without Landscape Architect's approval.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Follow requirements specified in referenced sections.

END OF SECTION 04 05 14

SECTION 04 22 00 - LANDSCAPE CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Landscape concrete unit masonry.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 05 11 - Landscape Masonry Mortaring.
 - 3. Section 04 05 14 - Landscape Masonry Grouting.
 - 4. Section 07 92 05 - Landscape Joint Sealers.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 2. A951 - Standard Specification for Masonry Joint Reinforcement.
 - 3. C90 - Standard Specification for Hollow Loadbearing Concrete Masonry Units.
- B. The Masonry Society (TMS) 402/602 - Building Code Requirements and Specifications for Masonry Structures.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Provide information on reinforcing including sizes, profiles, materials, and finishes.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 2 years experience in work of this Section.
- B. Perform Work in accordance with TMS 402/602.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect reinforcement from corrosion.

1.6 PROJECT CONDITIONS

- A. Wall Protection:
 - 1. During erection, cover tops of partially completed walls with strong waterproof membrane at end of each day or work stoppage.
 - 2. Extend cover minimum of 24 inches down both sides; hold securely in place.
- B. Load Application:
 - 1. Do not apply uniform loads for at least 12 hours after building masonry walls.
 - 2. Do not apply concentrated loads for at least 3 days after building masonry walls.
- C. Environmental Requirements:
 - 1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum 48 hours after installation.

2. Cold weather requirements: Do not use frozen materials or build on frozen work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Masonry Accessories:
 1. Blok-Lok Ltd. (www.blok-lok.com)
 2. Dur-O-Wal. (www.dur-o-wal.com)
 3. Heckmann Building Products. (www.heckmannbuildingprods.com)
 4. Hohmann and Barnard, Inc. (www.h-b.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Concrete Masonry Units:
 1. ASTM C90, hollow load bearing type, light weight.
 2. Size: Nominally 8 inches high x 16 inches long x thickness indicated.

2.3 ACCESSORIES

- A. Mortar: Specified in Section 04 05 11.
- B. Grout: Specified in Section 04 05 14.
- C. Joint Reinforcement:
 1. Ladder type; ASTM A951, hot-dip galvanized steel wire, 9 gage side rods with 9 gage cross ties.
 2. Width: Nominal wall thickness less 1-1/2 inches.
 3. Corner and tee fittings: Type to match reinforcement.
- D. Reinforcing Bars: ASTM A615/A615M, deformed billet steel, Grade 40 or 60.
- E. Joint Sealer: Specified in Section 07 92 05.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove dirt, loose rust, and other foreign matter from reinforcement.

3.2 INSTALLATION

- A. Establish lines, levels and courses indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimensions. Form horizontal and vertical joints of uniform thickness.
- C. Lay concrete masonry in running bond. Course one masonry unit and one mortar joint to equal 8 inches.
- D. Lay masonry plumb and level. Do not adjust masonry units after mortar has set.
- E. Lay masonry units with face shell bedding on head and bed joints.
- F. Do not butter corners or excessively furrow joints.

- G. Machine cut masonry with straight cuts and clean edges; prevent oversized or undersized joints. Discard damaged units. Do not expose cut cells.
- H. When joining fresh masonry to partially set masonry, remove loose masonry and mortar; clean and lightly wet exposed surface of set masonry.
- I. Stop horizontal runs by racking back normal bond unit in each course. Toothing not permitted.
- J. Horizontal Reinforcement:
 - 1. Place reinforcement at maximum 16 inches on center vertically and at topmost course.
 - 2. Extend minimum 24 inches each side of openings.
 - 3. Center reinforcing in wall.
 - 4. Lap ends 6 inches minimum; use fabricated tee and corner fittings at corners and intersections.
- K. Control Joints:
 - 1. Do not continue horizontal joint reinforcement through joints.
 - 2. Keep joints free from mortar and grout.
 - 3. Install joint backing and joint sealer at control joints in accordance with Section 07 92 05.
- L. Finishing Mortar Joints:
 - 1. Exposed locations: Tool joints to concave profile.
 - 2. Concealed locations: Cut joints flush.
- M. Reinforcing Bars:
 - 1. Position reinforcing accurately and hold securely in place to prevent displacement. Maintain minimum 1 inch space between masonry and reinforcing.
 - 2. Grout at intervals of not more than 60 inches in 6 to 8 inch lifts.
 - 3. Vibrate grout during and after placement to ensure complete filling.
 - 4. Stop grout 1-1/2 inch below top of masonry if grouting is stopped for 1 hour or more, except where completing grouting of finished wall.
- N. Installation Tolerances; Maximum variation from:
 - 1. Alignment face to face of adjacent units: Plus or minus 1/8 inch.
 - 2. Vertical alignment of head joints: Plus or minus 1/2 inch in 10 feet.
 - 3. True plane of wall: Plus or minus 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
 - 4. Plumb: Plus or minus 1/4 inch in 10 feet noncumulative; 1/2 inch in 20 feet or more.
 - 5. Level coursing: Plus or minus 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch in 30 feet.
 - 6. Joint thickness: Plus or minus 1/8 inch.

END OF SECTION 04 22 00

SECTION 04 42 00 - LANDSCAPE STONE ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Natural stone assemblies.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 05 11 - Landscape Masonry Mortaring.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. A153/A153M - Standard Specification for Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
 - 2. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. The Masonry Society (TMS) 402/602 - Building Code Requirements and Specifications for Masonry Structures.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Include location and sizes of pieces, arrangement and size of joints, anchorage details, and other details of installation.
 - 2. Product Data: Provide information on anchors including sizes, profiles, materials, and finishes.
 - 3. Samples: 12 x 12 inch stone samples showing each color and surface texture.

1.4 QUALITY ASSURANCE

- A. Fabricator and Installer Qualifications: Minimum 3 years experience in work of this Section.
- B. Obtain each stone from a single quarry and from the same area within the quarry.
- C. Mockup:
 - 1. Size: One typical table bench.
 - 2. Show:
 - a. Stone color and texture ranges.
 - b. Mortar joint size, color, and profile.
 - c. Bond pattern.
 - d. Anchors.
 - 3. Locate where directed.
 - 4. Approved mockup may remain as part of the Work.
- D. Perform Work in accordance with TMS 402/602.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store stone off ground; prevent contact with materials that could cause staining or damage.
- B. Protect anchors from corrosion.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Do not install stone when surrounding air or substrate surface temperature is below 40 degrees F or above 90 degrees F during or 48 hours after completion of the work.
 - 2. Do not install stone when wind velocity exceeds 15 MPH or relative humidity exceeds 70 percent.
 - 3. At end of working day and during rainy weather, cover work exposed to weather with waterproof coverings, securely anchored.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Stone:
 - 1. Type, size, color, and surface finish: Refer to Materials Legend.
 - 2. Free from defects that could impair its structural integrity or function. Inherent variations characteristic to quarry from which it is obtained are acceptable.

2.2 ACCESSORIES

- A. Mortar: Specified in Section 04 05 11.
- B. Anchors: Stainless steel, ASTM A666, Type 316.
- C. Cleaner: Type recommended by stone supplier.

2.3 FABRICATION

- A. Fabricate stone for uniform coloration between adjacent units and over full area of installation.
- B. Fabricate for 3/8 inch beds and joints.
- C. Cut or saw bed and joint surfaces square for full thickness of unit.
- D. Provide holes to accommodate anchors for attachment of stone.
- E. Fabrication Tolerances:
 - 1. Variation in width or height: Plus or minus 1/16 inch.
 - 2. Variation in thickness: Plus or minus 1/8 inch.
 - 3. Variation from true plane: Plus or minus 1/16 inch in 3 feet.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean stone prior to installation. Do not use wire brushes or implements that can mark or damage exposed surfaces.
- B. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.

3.2 INSTALLATION

- A. Arrange stone pattern to provide color uniformity and constant 3/8 inch joint sizes throughout.
- B. Set stone plumb and level.

- C. Set stone in full mortar setting bed; support stone over full bearing surface.
- D. Install anchors to secure stone to supporting construction.
- E. Tool joints to concave profile.
- F. Installation Tolerances; Maximum variation from:
 - 1. Plumb and level: Plus or minus 1/4 inch in 10 feet.
 - 2. Joint thickness: Plus or minus 1/8 inch.

3.3 CLEANING

- A. Clean stone with detergent and water applied with fiber brush.
- B. If initial cleaning does not produce acceptable results, apply cleaner in accordance with manufacturer's instructions.
 - 1. Protect adjacent and underlying surfaces and plant materials.
 - 2. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

3.4 PROTECTION

- A. Protect stone subject to damage by use of nonstaining sheet coverings.

END OF SECTION 04 42 00

SECTION 04 44 00 - COLLECTED STONE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Collected stone boulders.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM)D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).

1.3 QUALITY ASSURANCE

- A. Mockups:
 - 1. Size: One typical boulder of each size.
 - 2. Show: Stone size, color, and texture.
 - 3. Locate where directed.
 - 4. Approved mockups may remain as part of the Work.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Collected Stone Boulders:
 - 1. Existing boulders salvaged during onsite excavation operations.
 - 2. Clean stone using high pressure water; remove soil and foreign matter without damage to stone.
 - 3. Store boulders off ground after cleaning; protect from damage.

PART 3 EXECUTION

3.1 PREPARATION

- A. Compact soil to receive stones to minimum 95 percent of ASTM D698 standard proctor density at or near optimum moisture content.

3.2 INSTALLATION

- A. Orient boulders for best appearance.
- B. Place boulders on solid bearing.
- C. Obtain Landscape Architect's approval of location and appearance.

3.3 CLEANING

- A. Clean stone after installation using stiff brushes and water.

3.4 PROTECTION

- A. Protect stone subject to damage by use of nonstaining sheet coverings.

END OF SECTION 04 44 00

SECTION 05 12 00**STRUCTURAL STEEL FRAMING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Prefabricated building columns.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 05 12 13 "Architecturally Exposed Structural Steel Framing".
 - 3. Section 05 31 00 "Steel Decking".
 - 4. Section 05 50 00 "Metal Fabrications".
 - 5. Section 05 51 00 "Metal Stairs."
 - 6. Section 09 96 00 "High-Performance Coatings".
 - 7. Section 13 34 19 "Metal Building Systems".

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6 with flanges thicker than 1 1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents: The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
 - 2. AISC "Specification for Structural Steel Buildings," including the "Commentary" and the Supplements thereto, as issued.

3. AISC "Specification for Architecturally Exposed Structural Steel".
4. AISC's "Seismic Provisions for Structural Steel Buildings".
5. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use".
6. AWS D1.1 Structural Welding Code.
7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
9. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
10. UL Fire Resistance Directory.

- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.5 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: System as indicated on Drawings.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include a statement indicating cost for each product having recycled content.
 2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand critical welds.
 8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. At full penetration welds, Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Submit the following informational submittals:
1. Qualification Data: For qualified installer, fabricator, and testing agency.
 2. Welding certificates.
 3. Mill test reports for structural steel, including chemical and physical properties.
 4. Product Test Reports: For the following:
 - a. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - b. Direct-tension indicators.
 - c. Tension-control, high-strength bolt-nut-washer assemblies.
 - d. Shear stud connectors.
 - e. Shop primers.
 5. Source quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
 - 1. W-Shapes: 60 percent.
 - 2. Channels, Angles, M, S-Shapes: 60 percent.
 - 3. Plate and Bar: 25 percent.
 - 4. Cold-Formed Hollow Structural Sections: 25 percent.
 - 5. Steel Pipe: 25 percent.
 - 6. All Other Steel Materials: 25 percent.
- B. W-Shapes: Refer Structural General Notes.
- C. Channels, Angles, M, S-Shapes: Refer Structural General Notes.
- D. Plate and Bar: Refer Structural General Notes.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588, Grade 50.
- F. Cold-Formed Hollow Structural Sections: Refer Structural General Notes.
- G. Steel Pipe: Refer Structural General Notes.
 - 1. Weight Class: See Plans.
 - 2. Finish: Black except where indicated to be galvanized.
- H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers (All bolts located in Crawl Space): ASTM A 325, Type 1, heavy-hex steel structural bolts.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain or Mechanically deposited zinc coating, where required.

- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Unheaded Anchor Rods: ASTM F 1554, See Anchor Bolt Schedule on Drawings for Grade.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36 carbon steel.
 - 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 5. Finish:
 - a. General Condition – Plain
 - b. Crawl Space - Hot-dip zinc coating, ASTM A 153, Class C.
- F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- I. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Amscot Structural Products Corp.
 - b. Fluorocarbon Company Limited.
 - c. R.J. Watson Bridge & Structural Engineered Systems.
 - d. Seismic Energy Products, L.P.
 - 2. Mating Surfaces: PTFE and PTFE or mirror-finished stainless steel.
 - 3. Coefficient of Friction: Not more than 0.05.
 - 4. Design Load: Not less than 5,000 psi .
 - 5. Total Movement Capability: 2 inches.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer (General): Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Primer (Crawl Space Steel): Tnemec Perimeprime Series 394.
- D. Galvanizing Repair Paint: SSPC-Paint 20.

2.4 GROUT

- A. Refer Section 03 30 00.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.

3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in final approved Shop Drawings.
1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other effects.
 3. Camber structural steel members where indicated. The camber specified is the camber that is measured in the field with the beam on its side so that the beam weight has no effect. During shipment and handling, cambered members shall be supported in a way that will not result in loss of camber.
 4. Camber tolerance
 - a. Beams 50 feet and less; plus or minus 1/2 inch.
 - b. Beams greater than 50 feet; plus or minus 1/2 inch, except tolerance can be increased 1/8 inch for each 10 feet or fraction thereof in excess of 50 feet.
 - c. Contact engineer for members outside specified camber tolerance. Provide engineer with a list of beam locations and actual measured camber amounts. Submit an engineered shoring plan, if requested, that will allow the beam to deflect to the horizontal position after concrete placement without overloading the framing below.
 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."
- G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on approved shop drawings.
1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
 2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes by burning.
- I. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Base plates hole sizes for anchor bolts may be oversized to facilitate erection:
1. Bolts 3/4 inch to 7/8 inch diameter: 1/2 inch oversize.
 2. Bolts 1 inch to 1 1/2 inch diameter: 3/4 inch oversize.
 3. Bolts over 1 3/4 inch diameter: 1 inch oversize.
- J. Base Plate Washers: Sizes shall be as follows:
1. 3/4 inch diameter Bolts: 2 inch diameter x 1/4 inch thick
 2. 7/8 inch diameter Bolts: 2 1/2 inch diameter x 5/16 inch thick
 3. 1 inch diameter Bolts: 3 inch diameter x 3/8 inch thick
 4. 1 1/4 inch diameter Bolts: 3 inch diameter x 1/2 inch thick

5. 1 1/2 inch diameter Bolts: 3 1/2 inch diameter x 1/2 inch thick
6. 1 3/4 inch diameter Bolts: 4 inch diameter x 5/8 inch thick
7. 2 inch diameter Bolts: 5 inch diameter x 3/4 inch thick

- K. Architecturally Exposed Structural Steel (AESS): Fabricate with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
 2. Comply with fabrication requirements, including tolerance limits, of AISC's "Specification for Architecturally Exposed Structural Steel" for architecturally exposed structural steel.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, Pretensioned, or Slip critical as required or indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, where required, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing) excluding crawl space steel. Crawl space steel shall be primed regardless of whether it is to receive fireproofing.
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- D. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- E. Crawl space steel to be primed to a DFT between 2.5 and 3.5 mils.
- F. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.
- G. GALVANIZING
- H. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels and shelf angles attached to structural steel frame and located in exterior walls.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Refer Section 01 45 23.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations, to elevations indicated, and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow it to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, Pretensioned, or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

SECTION 05 50 05 - LANDSCAPE METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Shop fabricated metal components.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. American Welding Society (AWS) D1.1/D1.1M - Structural Welding Code - Steel.
- B. ASTM International (ASTM):
 - 1. A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel.
 - 2. A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance.
 - 3. A606/A606M - Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
 - 4. A847/A847M - Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Show dimensions, metal thicknesses, finishes, joints, attachments, and relationship of work to adjacent construction.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store steel above ground on platforms, skids, or other supports; separate with wooden separators.
- B. Protect steel from corrosion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Weathering Steel:
 - 1. Sheet: ASTM A606/A606M.
 - 2. Shapes: ASTM A588/A588M.
 - 3. Plate: ASTM A242/A242M.
 - 4. Tubing: ASTM A847/A847M.

2.2 ACCESSORIES

- A. Exposed Screws: Series 300 stainless steel, Phillips flat head, countersunk, unless noted otherwise.

2.3 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of component except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Conceal fastenings where possible.
- G. Welding to conform to AWS D1.1/D1.1M:
 - 1. Use welds for permanent connections where possible. Grind exposed welds smooth.
 - 2. Tack welds prohibited on exposed surfaces.

2.4 FINISHES

- A. Weathering Steel: Mill finish.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with approved Shop Drawings.
- B. Install components plumb, level, and rigid.
- C. Welding: AWS D1.1/D1.1M. Grind and fill exposed welds; finish smooth and flush.
- D. Install sleeved components with anchoring cement.
- E. Prevent contact of dissimilar metals by use of zinc rich paint, bituminous coating, or non-absorptive gaskets.

END OF SECTION 05 50 05

SECTION 05 52 05 - LANDSCAPE METAL RAILINGS**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Shop fabricated metal components.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. American Welding Society (AWS) D1.1/D1.1M - Structural Welding Code - Steel.
- B. ASTM International (ASTM):
 - 1. A847/A847M - Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.
 - 2. E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Show dimensions, metal thicknesses, finishes, joints, attachments, and relationship of work to adjacent construction.
- B. Quality Control Submittals:
 - 1. Certificate of Compliance from Professional Structural Engineer performing system design.

1.4 SYSTEM DESCRIPTION

- A. Minimum Design Loads:
 - 1. Railings:
 - a. 50 pounds per linear foot applied in any direction at top, transferred via attachments and supports to building structure.
 - b. Concentrated 200 pound load applied in any direction at any point along top, transferred via attachments and supports to building structure.
 - c. Maximum deflection under loading: L/120.
 - 2. Concentrated and uniform loads do not need to be applied simultaneously.
 - 3. Perform design under direct supervision of Professional Structural Engineer licensed in State in which Project is located, with minimum 2 years experience in work of this Section.
- B. Fabricate railings in accordance with ASTM E985.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store steel above ground on platforms, skids, or other supports; separate with wooden separators.
- B. Protect steel from corrosion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Weathering Steel Tubing: ASTM A847/A847M.

2.2 ACCESSORIES

- A. Anchoring Cement: Non-shrink cementitious type.

2.3 FABRICATION

- A. Fabricate railings from weathering steel stock of sizes indicated.
- B. Make bends uniform and free from buckles and other defects.
- C. Cut intersections square to within 2 degrees and to length within 1/8 inch. Remove burrs from cut ends.
- D. Miter and cope intersections within 2 degrees, fit to within 1/8 inch.
- E. Continuously weld connections. Welding to conform to AWS D1.1/D1.1M:
 - 1. Use welds for permanent connections where possible. Grind exposed welds smooth.
 - 2. Tack welds prohibited on exposed surfaces.
- F. Where length exceeds that suitable for shipping and handling, fabricate in sections with concealed internal sleeves forming slip joints. Extend sleeves minimum 2 inches on both sides of joint; field weld and grind smooth.
- G. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of component except where specifically noted otherwise.
- H. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- I. Conceal fastenings where possible.

2.4 FINISHES

- A. Weathering Steel: Mill finish.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with approved Shop Drawings.
- B. Install components plumb, level, and rigid.
- C. Welding: AWS D1.1/D1.1M. Grind and fill exposed welds; finish smooth and flush.
- D. Install sleeved components with anchoring cement.

END OF SECTION 05 52 05

SECTION 06 15 00 - WOOD DECKING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood decking.
 - 2. Anchors.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. American Wood Protection Association (AWPA) U1 - Use Category System - User Specification for Treated Wood.
- B. ASTM International (ASTM) F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
- C. National Institute of Standards and Technology (NIST) - Product Standard PS 20 - American Softwood Lumber Standard.
- D. Western Wood Products Association (WWPA) G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Samples:
 - a. 12 inch long decking samples.
 - b. Anchor and fastener samples.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 2 years experience in work of this Section.
- B. Lumber Grading Agency: Certified to NIST PS 20.
- C. Identify lumber by official grade mark.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials minimum 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation.
- B. Do not store materials in damp location.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Wood Decking:
 - 1. Base Bid: Refer to Materials Schedule.
 - 2. Alternate Bid:
 - a. Grading rules: WWPA.
 - b. Species: Spruce, Pine, or Fir.

- c. Grade: No. 2.
- d. Surfacing: Surfaced four sides (S4S).
- e. Maximum moisture content: 19 percent.

2.2 ACCESSORIES

- A. Deck Anchors:
 - 1. Type: Concealed deck anchors design to secure two adjacent boards with uniform spacing between while allowing for thermal movement.
 - 2. Material: 300 Series stainless steel.
- B. Fasteners:
 - 1. Type and size: As required by conditions of use.
 - 2. Material: Stainless steel, ASTM F593, Type 304 or 316.

2.3 FABRICATION

- A. Preservative Treatment: Treat framing lumber products in accordance with AWPA U1, Category UC3B - Above Ground/Exposed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Cut ends square and true. Sand cut ends and edges where exposed.
- B. Place decking to pattern indicated on Drawings.
- C. Leave 1/8 inch spaces between adjacent decking boards and between decking and adjacent construction.
- D. Place each decking board to span three or more supports.
- E. Place deck anchors between adjacent decking boards at each support; secure anchors to supports.

3.2 TOLERANCES

- A. Maximum Variation in Surface Flatness: 1/4 inch in 10 feet.
- B. Maximum Offset in Plane at Adjoining Members: 1/8 inch.

END OF SECTION 06 15 00

SECTION 07 92 05 - LANDSCAPE JOINT SEALERS**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Joint sealers for other sections referencing this Section.
 - 2. Joint backup materials.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C920 - Standard Specification for Elastomeric Joint Sealants.
 - 2. C1193 - Standard Guide for Use of Joint Sealants.
 - 3. C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - 4. C1472 - Standard Guide for Calculating Movement and Other Effects When Establishing Sealant Joint Width.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Indicate sealers, primers, bond breakers, and accessories proposed for use.
 - 2. Samples:
 - a. 1/2 x 1/2 x 3 inch long joint sealer samples showing available colors.
 - b. 6 inch long joint backup material samples.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum 2 years experience in work of this Section.

1.5 PROJECT CONDITIONS

- A. Do not apply sealers at temperatures below 40 degrees F unless approved by sealer manufacturer.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Acceptable Manufacturers:
 - 1. BASF Building Systems. (www.buildingsystems.basf.com)
 - 2. Dow Corning Corp. (www.dowcorning.com)
 - 3. GE Silicones. (www.siliconeforbuilding.com)
 - 4. Pecora Corp. (www.pecora.com)
 - 5. Sika Corp. (www.sikausa.com)
 - 6. Tremco, Inc. (www.tremcosealants.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Joint Sealer Type 1:
 - 1. ASTM C920, Grade P, multiple component polyurethane type, self-leveling and slope grades.
 - 2. Movement capability: Plus or minus 25 percent.
 - 3. Color: To be selected from manufacturer's full color range.
 - 4. Uses: Joints in horizontal surfaces subject to pedestrian or vehicular traffic.
- B. Joint Sealer Type 2:
 - 1. ASTM C920, Grade NS, single component silicone type, nonstaining, non sag.
 - 2. Movement capability: Plus or minus 50 percent.
 - 3. Color: To be selected from manufacturer's full color range.
 - 4. Uses: Joints in vertical surfaces.

2.3 ACCESSORIES

- A. Primers, Bondbreakers, and Solvents: As recommended by sealer manufacturer.
- B. Joint Backing:
 - 1. ASTM C1330, bi-cellular polyethylene foam, preformed round joint filler, non absorbing, non staining, resilient, compatible with sealer and primer, recommended by sealer manufacturer for each sealer type.
 - 2. Size: Minimum 1.25 times joint width.

2.4 MIXES

- A. Mix sealers in accordance with manufacturer's instructions.
 - 1. Mix with mechanical mixer; prevent air entrainment and overheating.
 - 2. Continue mixing until color is uniform.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove loose and foreign matter that could impair adhesion. If surface has been subject to chemical contamination, contact sealer manufacturer for recommendation.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Protect adjacent surfaces with masking tape or protective coverings.
- D. Calculate joint dimensions in accordance with ASTM C1472.

3.2 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Install sealers and accessories in accordance with ASTM C1193.
- C. Install joint backing to maintain required sealer dimensions. Compress backing approximately 25 percent without puncturing skin. Do not twist or stretch.
- D. Use bondbreaker tape where joint backing is not installed.
- E. Fill joints full without air pockets, embedded materials, ridges, and sags.

- F. Tool sealer to smooth profile.
- G. Apply sealer within manufacturer's recommended temperature range.

3.3 CLEANING

- A. Remove masking tape and protective coverings after sealer has cured.
- B. Clean adjacent surfaces.

END OF SECTION 07 92 05

SECTION 260500 -BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Electrical Specification on Drawing OE001 and specific notes on drawings provided by TPWD should take priority over this set of specifications.
- C. These Specifications are intended to supplement TPWD specifications and shall be used only if TPWD do not cover some of the project requirements.

1.2 SUMMARY

- A. Provide an installation complete in every respect. Furnish and install material and equipment usually furnished with such systems or required to complete the installation. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to furnish same as well as furnish and install material and equipment usually furnished with such systems or required to complete the installation.
- B. This Section includes the following:
 - 1. Supporting devices for electrical components.
 - 2. Concrete equipment bases.
 - 3. Codes, fees, permits, standards, inspections, field quality control, and submittal requirements.
 - 4. Electrical excavation and backfill.
 - 5. Project record documentation.
 - 6. Safety guards.
 - 7. Space and equipment arrangement.
 - 8. Refinishing and touchup painting.
 - 9. Cleaning and protection of apparatus.
 - 10. Electrical component identification.

1.3 CODES, FEES, PERMITS, STANDARDS AND INSPECTIONS

- A. Work performed under these Specifications shall be in strict accordance with the National Electrical Code (NFPA 70 Latest Edition) Occupational Safety and Hazard Act (OSHA), Institute of Electrical and Electronic Engineers (IEEE), Underwriter's Laboratory (UL), National Fire Protection Association (NFPA), all applicable City, County, State, and National codes, specifications, standards and ordinances, and in accordance with all Utility Company regulations.
- B. If discrepancies occur, the Contractor shall immediately notify the Architect in writing of said discrepancies and apply for an interpretation.

- C. In case of difference between building codes, specifications, state laws, industry standards and the Contract Documents, the most stringent shall govern.
- D. Refer to conditions of the Contract for payment of fees and permits.
- E. Work must be performed by electrical contractors and electricians licensed in the state of Texas.

1.4 DEFINITIONS:

- A. Approved: As specified or having received Architect's approval.
- B. Furnish: Purchase and deliver to job site.
- C. Install: Fix permanently in place and make all necessary connections as related to all trades involved, place in operation, and test.
- D. Provide: Furnish and install.
- E. Replace: Remove and provide.
- F. Relocate: Remove and install in new location.
- G. Contractor: Contractor responsible for all trades under the specifications covered by this Division.
- H. Work : Labor and/or materials accruing in the provision of a system as defined by the drawings and these specifications.
- I. Store: Provide an environmentally controlled space to protect the stored equipment from damage prior to installation.
- J. Remove: De-energize, disconnect, and de-commission the designated equipment as related to the trades required to take the equipment out of service. This shall include transporting the equipment to an off-site location as required by authorities having jurisdiction and regulatory agencies, unless directed otherwise by the Architect.

1.5 SUBMITTALS

- A. The following shall document the materials and methods of the installation.
 - 1. Shop Drawings.
 - 2. Field Test Reports.
 - 3. Commissioning and Startup Documentation.
 - 4. Coordination Drawings.
 - 5. Submittal Schedule.
 - 6. Compliance and Deviation Statement for each specification section.

1.6 QUALITY ASSURANCE

- A. Provide products and materials that are UL listed and UL labeled.
- B. Materials shall be new and of the quality specified.

- C. Equipment installed shall have local representation, local factory authorized service, and a local stock of repair parts, within 100 miles of the Project site.
- D. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power, communications, and other services.
- E. Equipment Changes: The electrical design and drawings are based on the equipment scheduled, specified and indicated by the drawings and should any equipment requiring changes to the electrical design be approved, the required electrical changes shall be made at the expense of the Contractor at no cost to the Owner.

1.7 PRODUCT UNIFORMITY

- A. The following categories of equipment shall be provided by a single manufacturer:
 - 1. Electrical distribution equipment.
 - 2. Fuses.
 - 3. Wiring devices.

1.8 WORK SEQUENCE COORDINATION

- A. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.
- B. Coordinate electrical service connections to components furnished by utility companies. Coordinate installation and connection of underground and overhead utilities and services, including provision for electricity-metering components.

1.9 PROJECT RECORD DOCUMENTS AND RECORDS FOR OWNER

- A. Project record documentation and records for the Owner shall be as specified in Division 1, General Requirements Section.
- B. In addition to the Division 1 of these specification provide the following minimum items:
 - 1. Operations & Maintenance Manuals: Include, as appropriate to each item, sufficient information to provide for the Owner's operation and maintenance of equipment furnished.
 - 2. As-Builts: Provide three (3) sets of the following:
 - a. Electronic drawings files using the drawing software used for the project, in Revit "RVT" format, of all documents flash drives, corrected with "As Installed" work including branch circuiting and circuit designation, feeder identification and wire sizes, location of concealed work, location of wiring devices, underground utilities, and similar items.
 - b. Electronic drawings files, in "PDF" format, of all documents on flash drives, corrected with "As Installed" work.
 - c. All as-builts shall be updated using the project software used for the drawings (Revit files).
 - 3. Contacts: Include with each product, name, address, and telephone numbers, of installing contractor, factory and local service representative.
 - 4. Instructions of Owner's Personnel: Prior to final inspection and acceptance, fully instruct the Owner's designated operating and maintenance personnel in the operating and performance of the equipment furnished.
 - 5. Warranties: Include warranty information properly executed by respective manufacturers, suppliers, or sub-contractors for the equipment and system furnished.

1.10 WARRANTY

- A. Project warranty shall be as specified in Division 1, General Requirements Section, but not less than one (1) year from final acceptance.

1.11 SAFETY GUARDS

- A. Contractor shall furnish and install all safety guards required.

1.12 SPACE AND EQUIPMENT ARRANGEMENT

- A. Size of equipment shown by the drawings is based on the dimensions of a particular manufacturer. Where other manufacturers are acceptable, it is the responsibility of the contractor to determine if the equipment he proposes to furnish will fit the space.

1.13 PROTECTION OF MATERIALS AND APPARATUS

- A. At all times take such precautions as may be necessary to properly protect the electrical apparatus from damage. This shall include the creation of all required temporary shelters and environmental control to adequately protect any electrical apparatus. Electrical apparatus shall be cribbed up from the floor and covered with protective coverings where necessary to protect the apparatus from damage.
- B. As required, apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.
- C. Damage resulting from failure to comply with this requirement will be considered justification for rejection of the damaged apparatus and requiring its complete replacement by the Contractor.

1.14 INSPECTION OF BUILDING SITE:

- A. Contractor shall visit the site, verifying all existing items indicated on plans and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil, conditions, and local requirements. The submission of bids shall be deemed evidence of each visit. All Proposals shall take these existing conditions into consideration, and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.

1.15 EXCAVATION AND BACKFILL

- A. Provide all necessary excavation and backfill for the installation of electrical work in accordance with Division 2 of these Specifications.
- B. Trenches for all underground conduits shall be excavated to the required depths. The bottoms of the trenches shall be tamped hard and evenly graded to assure the conduit is supported for its entire length on solid ground. Should rock be encountered, it shall be removed and backfilled to the proper grade with pea gravel or select fill thoroughly tamped. Conduit laid in trenches dug in fill shall be supported on thoroughly tamped load bearing soil. After the conduits have been inspected and approved by inspecting authorities, the trenches shall be backfilled.

- C. Trenches shall be carefully backfilled with select fill material, or pea gravel, to a depth of 6 inches above the top of the conduit. The next layer and subsequent layers of backfill may be excavated materials if of earth, loam, sand or gravel, free of large clods and with rocks no larger than 1-1/2-inch (38-mm) in diameter. Backfill shall be installed in layers 12-inches (300-mm) deep, adequately tamped and wetted down or flushed before the second layer of earth is laid in place.
- D. Underground cables or conduits shall be installed in accordance with the National Electrical Code, but in no case shall the buried depth be less than 24-inches (600-mm) below finished grade.

PART 2 - PRODUCTS

2.1 SUPPORTS

- A. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- B. Cable Supports for Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs shall have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- C. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel
- D. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm) diameter slotted holes at a maximum of 2 inches (50 mm) on centers in webs.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.

2.2 TERMINATIONS AND LUGS

- A. Termination Lug Sizes and Capacities: The Contractor shall review the entire set of Project Documents, including all Divisions of the Work, for coordination with feeder and branch circuit wiring and associated termination lug sizes and capacities for all equipment installed on the Project including Owner Furnished Equipment.

2.3 IDENTIFICATION

- A. See requirement on OE001.

PART 3 - EXECUTION

3.1 SERVICES

- A. Scope of Work: Furnish all materials and equipment and perform all labor and services necessary to complete the installation of the new electrical services and the installation of underground primary service requirements (PVC conduit provisions) and communication service conduit on site and to the buildings as indicated by the drawings and as specified herein.

- B. Electrical Service: Electrical service equipment shall be of the characteristics, size and capacity indicated by the drawings. The service shall be continuous without splice from the power company connections to the main disconnect/or load center and shall be as specified under Division 26 sections specifying raceways and conductors. Primary electrical service shall include the service raceways and fittings required by the power company.
 - C. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
 - D. Meter Sockets: Comply with requirements of electrical power utility company.
 - E. Equipment Pads: Concrete pads required for the electrical service shall be provided as indicated on drawings unless provided by the Power Company. The contractor shall obtain the required information from the Power Company as to the construction of the concrete pad(s).
- 3.2 If the criteria in this specification are not followed and upon notification by the Architect and Engineer of a deficiency, the Contractor shall, at not additional cost to the Project, relocate conduits, feeders, branch circuits, disconnects, and other equipment to provide the maximum possible headroom.
- A. Materials and Components: Install level, plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
 - B. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
 - C. Right of Way: Give to raceways and piping systems installed at a required slope.
- 3.3 WIRING METHODS
- A. Splices and Taps: Installation shall be compatible with conductor material and shall possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - B. Wiring at Outlets: Install wiring at outlets with at least 12 inches (300 mm) of slack conductor at each outlet.
 - C. Electrical Capacities: Verify the electrical capacities of all motors and electrical equipment furnished under the other sections of these specifications and install wiring as required to completely connect all equipment requiring electrical power.
 - D. Power Wiring: Except for such items that are normally wired at their point of manufacture and so delivered and, unless specifically noted to the contrary herein, the Contractor shall do all electric wiring for power supply.
 - E. Equipment Furnished Under Other Sections: Install all motors, starters, and miscellaneous items of electrical equipment furnished under other sections of these specifications that are not integrally mounted with their equipment. All such equipment shall be securely mounted in a neat and workmanlike manner.
- 3.4 CONCRETE BASES
- A. Construct concrete bases not less than 4 inches (100 mm) larger, around the exposed perimeters, than the supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Concrete strength and reinforcement shall be as specified in Division 3 of these specifications.

3.5 FIELD QUALITY CONTROL

- A. Inspect installed components for damage or faulty work and repair or replace as necessary. The following minimum items shall be inspected:
 - 1. Raceways and junction boxes.
 - 2. Wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Cutting and patching for electrical construction.
 - 5. Refinishing and touchup painting.
 - 6. Firestopping and fireproofing material.
 - 7. Safety guards.
 - 8. Equipment identification.
 - 9. Grounding and lightning protection systems
 - 10. Lighting and lighting control system.
 - 11. Electrical distribution equipment.

3.6 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and Touch Up Paint. Paint materials and application requirements shall be as specified in Division 9 of these specifications.

3.7 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00

SECTION 260520 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Electrical Specification on Drawing OE001 and specific notes on drawings provided by TPWD should take priority over this set of specifications.
- C. These Specifications are intended to supplement TPWD specifications and shall be used only if TPWD do not cover some of the project requirements.

1.2 SUMMARY

- A. This Section includes building wires and cables with associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Product data for wire, cable, connectors, and conductor splices.

1.4 QUALITY ASSURANCE

- A. Provide wires and cables specified in this Section that are listed and labeled. The Terms "Listed" and "Labeled" shall be as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.
- B. Comply with the current edition of NFPA 70 or the edition adopted by local Authorities with amendments where applicable.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle wires and cables according to applicable NEMA standards.

1.6 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations as required to suit field conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements herein specified and as approved by the Authority Having Jurisdiction. Provide products by one of the following or approved equal:
 - 1. Wires and Cables:
 - a. Carol Cable Co., Inc.
 - b. Senator Wire & Cable Company.
 - c. Southwire Company.
 - d. Okonite Company
 - e. Perilli Cables North America
 - 2. Connectors for Wires and Cables:
 - a. AMP Incorporated.
 - b. General Signal; O-Z/Gedney Unit.
 - c. Monogram Co.; AFC.
 - d. Square D Co.; Anderson.
 - e. 3M Company; Electrical Products Division.

2.2 WIRES AND CABLES

- A. General: UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified herein shall comply with applicable NEMA standards.
- B. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
- C. Control wire: Copper stranded only.
- D. Material: Copper.
- E. Material: Aluminum for wiring allowed for #3/0 AWG and larger, for feeders and services only.

2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as herein specified.
- B. Avoid splicing conductors for underground conduits runs in flush-with-grade pullboxes. Conductors shall be installed continuous from point to point.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type THWN in raceway.
- B. Feeders: Type THHN/THWN, in raceway.
- C. Branch Circuits: Type THHN/THWN, in raceway.
- D. Class 1 Control Circuits: Type THHN/THWN, in raceway.
- E. Class 2 Control Circuits: Type THHN/THWN, in raceway for control systems.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Before wire is pulled into conduit, the conduit shall be thoroughly swabbed in such a manner as to remove all foreign material, and to permit the wire to be pulled into a clean dry conduit.
- C. Minimum wire size for power and lighting branch circuits shall be No. 12 AWG. Minimum wire size for control circuits shall be No. 14.
- D. Use manufacturer-approved pulling compound or lubricant where necessary. Compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- E. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- F. Unless larger sizes are indicated otherwise on the contract drawings, provide No. 10 AWG conductors for 20 Amp, 120 Volt branch circuit homeruns longer than 60 feet and No. 8 AWG conductors for 20 Amp, 120 Volt branch circuit homeruns longer than 120 feet.
- G. Unless noted otherwise, branch circuit wiring may be combined into a single raceway in accordance with the NEC provided the conductors are properly derated. All neutral conductors shall be considered current carrying conductors. The maximum number of circuits that can be combined into a single raceway is six (6).

3.4 CONNECTIONS

- A. No splicing or joints will be permitted in branch circuits except at outlets or accessible junction boxes. Branch circuits of #1 or larger shall run their entire length without joints or splices. Service and feeder circuits shall run their entire length without joints or splices.
- B. In the making of a splice, connectors shall be brought up securely upon the conductors in such a way that all conductors are equally engaged, the insulation is not ruptured and no bare wires are exposed or have "backed-off" due to the application of pressure.
- C. Screw-on pigtail connectors may be used for splicing wire up to and including No. 8 AWG. Wires shall be twisted together with a minimum of one turn of the stripped conductors before insertion into connectors. Connectors shall be installed so that the conductor is fully insulated by a skirt, or taped in such a manner that cold flow of the insulation will not be induced when the conductor is positioned in its final operational position.

- D. Terminations or splices for copper conductors No. 6 AWG and larger shall utilize copper bolt clamp-type connectors or hydraulically crimped copper crimp connectors UL approved for the application in which they are used. Crimped connectors shall be applied using only tooling specifically recommended by the connector manufacturer, and tooling shall not release the connector until proper crimping force has been achieved.
- E. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- F. Use splice and tap connectors compatible with conductor material.
- G. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

END OF SECTION – 26 05 20

SECTION 260530 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Electrical Specification on Drawing OE001 and specific notes on drawings provided by TPWD should take priority over this set of specifications.
- C. These Specifications are intended to supplement TPWD specifications and shall be used only if TPWD do not cover some of the project requirements.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
 - 1. Raceways include the following:
 - a. Rigid Metal Conduit (RMC).
 - b. Intermediate Metal Conduit (IMC).
 - c. PVC externally coated IMC.
 - d. Electrical Metallic Tubing (EMT).
 - e. Flexible Metal Conduit (FMC).
 - f. Rigid Nonmetallic Conduit (RNC).
 - g. Wireways.
 - h. Surface raceways.
 - 2. Boxes, enclosures, and cabinets include the following:
 - a. Device boxes.
 - b. Outlet boxes.
 - c. Pull and junction boxes.
 - d. Cabinets and hinged-cover enclosures.

1.3 SUBMITTALS

- A. Product Data: For conduits, fittings, expansion joints assembly, through-wall and floor seals assembly, surface raceways, wireways, floor boxes, hinged-cover enclosures, and cabinets.

1.4 QUALITY ASSURANCE

- A. Listed and Labeling: Provide products specified in this Section that are listed and labeled. The Terms "Listed" and "Labeled" shall be as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.
- B. Standards: Comply with applicable UL and NEMA Standards. Comply with NECA's "Standard of Installation."

1.5 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
1. Metal Conduit and Tubing:
 - a. Carol Cable Co., Inc.
 - b. Grinnell Co.; Allied Tube and Conduit Div.
 - c. Monogram Co.; AFC.
 - d. Wheatland Tube Co.
 2. Nonmetallic Conduit and Tubing:
 - a. Anamet, Inc.; Anaconda Metal Hose.
 - b. Arnco Corp.
 - c. Cantex Industries; Harsco Corp.
 - d. Condux International; Electrical Products.
 - e. Hubbell, Inc.; Racor, Inc.
 - f. Lamson & Sessions; Carlon Electrical Products.
 - g. Thomas & Betts Corp.
 3. Conduit Bodies and Fittings:
 - a. American Electric; Construction Materials Group.
 - b. Crouse-Hinds; Div. of Cooper Industries.
 - c. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. O-Z/Gedney; Unit of General Signal.
 4. Metal Wireways:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
 5. Nonmetallic Wireways:
 - a. Hoffman Engineering Co.
 - b. Lamson & Sessions; Carlon Electrical Products.
 6. Surface Metal Raceways:
 - a. Airey-Thompson Co., Inc.; A-T Power Systems.
 - b. American Electric; Construction Materials Group.
 - c. Wiremold Co. (The); Electrical Sales Division.
 7. Surface Nonmetallic Raceways:
 - a. Anixter Brothers, Inc.
 - b. Butler Manufacturing Co.; Walker Division.
 - c. Hubbell, Inc.; Wiring Device Division.
 - d. JBC Enterprises, Inc.; Enduro Fiberglass Systems.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. Panduit Corp.
 - g. Wiremold Co. (The); Electrical Sales Division.
 8. Boxes, Enclosures, and Cabinets:
 - a. Crouse-Hinds; Div. of Cooper Industries.
 - b. Electric Panelboard Co., Inc.
 - c. Erickson Electrical Equipment Co.
 - d. Hoffman Engineering Co.; Federal-Hoffman, Inc.

- e. Hubbell Inc.; Raco, Inc.
- f. Carlon Electrical Products.
- g. O-Z/Gedney; Unit of General Signal.
- h. Thomas & Betts Corp.

2.2 METAL CONDUIT AND TUBING

- A. General: UL-Listed conduit and tubing with material herein specified shall comply with applicable NEMA and ANSI Standards.
- B. EMT Fittings: EMT fittings for power, lighting or control circuits shall be compression type.
- C. Material: Aluminum or zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.
- E. Moisture Sealing: Sealing assembly around conduits passing through concrete wall or floor equal with O-Z Gedney type "FSK".

2.3 NONMETALLIC CONDUIT AND TUBING

- A. General: UL-Listed non-metallic conduit and tubing with material herein specified shall comply with applicable NEMA and ANSI Standards.
- B. Type: Non-metallic conduit and tubing shall be Schedule 40, PVC or schedule 80 where required by power company.
- C. Fittings: Matched to conduit or tubing type and material.

2.4 METAL WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, , adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Standard covers shall be hinged type unless noted otherwise. Provide flanged and gasketed type covers when required by the application or installation.
- D. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

- A. Description: PVC plastic extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections using plastic fasteners.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.6 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
- C. Accessories: Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.7 OUTLET, DEVICE, PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: UL-Listed, galvanized steel metal boxes shall comply with applicable NEMA and ANSI Standards.
- B. Cast-Metal Outlet Boxes: UL-Listed, Type FD, cast box with gasketed cover.
- C. Cast-Metal Boxes: UL-Listed cast aluminum with gasketed cover.

2.8 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: Enclosures shall be UL-Listed, comply with applicable NEMA and ANSI Standards, and provided with continuous hinge cover and flush latch. Provide galvanized steel with manufacturer's standard enamel finish inside and out.
- B. Cabinets: Cabinets shall be UL-Listed, comply with applicable NEMA and ANSI Standards. Provide galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: RMC, IMC or EMT as indicated on the drawings.
 - 2. Underground: PVC.
 - 3. Connection to Vibrating Equipment: LFMC.
 - 4. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
 - 5. Dump and Lift Stations: Boxes and enclosures: NEMA 4X, corrosion resistant, non-metallic.
 - 6. Lake Dock Area: Corrosion resistant, non-metallic enclosures, conduit, boxes, supports, and hardware.

3.3 INSTALLATION

- A. All wiring shall be installed in conduit or raceways. Direct buried wires not allowed.
- B. Provide PVC or PE conduits for underground routes. Use corrosion protected, rigid metal conduit for all riser conduits and elbows stub-up points. For short stub-ups (less than 24" above grade below enclosure) use schedule 80PVC conduits.
- C. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- D. Minimum raceway size for home runs shall be 3/4-inch trade size.
- E. Install raceways level and square, at proper elevations.
- F. Use temporary closure devices to prevent foreign matter from entering raceways.
- G. Protect stub-ups from damage where conduits rise through. Arrange so curved portion of conduit bend is not visible above the finished slab.
- H. Make bends and offsets so inside diameter is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- I. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- J. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- K. All underground change of directions shall be made with factory applied PVC coated rigid, factory applied PVC coated IMC steel, or UL Schedule 40 PVC elbows.
- L. Join raceways with fittings designed and approved for the purpose and make joints tight. Make raceway terminations tight and use insulating bushings to protect conductors.
- M. Tighten set-screws of threadless fittings with suitable tools.
- N. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with a single locknut, use multiple locknuts (i.e., one inside and one outside the box).
- O. Where EMT enters a box, the joint between the connector and the box shall be made tight, in an approved manner, by a steel compression fitting with an insulated throat device.
- P. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- Q. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90 kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.
- R. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish

similar to that of adjacent plates or surfaces. Install raceway sealing fittings where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.

- S. Do not install aluminum conduits embedded in or in contact with concrete.
- T. The installation of metallic conduits shall result in the conduit being used as an equipment grounding conductor in accordance with Article 250 of the latest edition of the National Electrical Code.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, which ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
- B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

- A. Upon completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 260530

SECTION 260560 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Electrical Specification on Drawing OE001 and specific notes on drawings provided by TPWD should take priority over this set of specifications.
- C. These Specifications are intended to supplement TPWD specifications and shall be used only if TPWD do not cover some of the project requirements.

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

- A. Product Data: For each product specified including grounding conductors, clamps and accessories.

1.4 QUALITY ASSURANCE

- A. Provide products specified in this Section that are listed and labeled. The Terms "Listed" and "Labeled" shall be as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.
- B. Grounding system ground resistance shall not exceed 25 ohms.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Erico Inc. (Caldweld)
 - b. Burndy Electrical Products.
 - c. Heary Brothers Lightning Protection Co.
 - d. Lyncole XIT Grounding.
 - e. O-Z/Gedney Company
 - f. Thomas & Betts Electrical Products.

2.2 PRODUCTS

- A. Conductors: Comply with Division 26 Section "Conductors and Cables" for insulated conductors. All conductors shall be copper, stranded, and insulated, unless noted otherwise.
- B. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.
- C. Connectors: Comply with IEEE 837 and UL 467 for listed use of specific types, sizes, and combinations of conductors and connected items. Mechanical connectors shall be bolted-pressure-type connectors, or compression type. Welded connectors shall be exothermic-welded type, in kit form, and selected per manufacturer's written instructions.
- D. Ground Rods: Copper-clad 3/4 inch diameter by 120 inches in length (19 by 3000 mm).
- E. Ground Plates: Copper-clad minimum 12" x 24" x 20 gauge as manufactured by Heary Brothers Model #HB54-C or approved equal. Ground plates shall be provided with two (2) bolt plates, which shall be attached utilizing stainless steel nuts & bolts.

PART 3 - EXECUTION

3.1 APPLICATION

- A. General: Provide adequate and permanent equipment grounding in accordance with NFPA 70, and subject to the additional requirements herein specified. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone and similar materials. Install conductors in raceways for physical protection unless noted otherwise. Use exothermic-welded connections for connections to structural steel and for underground connections.
- B. Raceways: Install insulated equipment grounding conductors in ALL raceways of ALL systems. Assure the electrical continuity of all metallic raceway systems, pulling up all conduits and/or locknuts wrench-tight. Provide grounding bushings on all feeder raceways terminating within panelboards. Install grounding jumpers from these bushings to the equipment ground bus where one occurs or to ground lugs mounted to the frame of the enclosures.
- C. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.2 INSTALLATION

- A. Ground Rods: Drive ground rods until tops are 2 inches (50 mm) below final grade, unless otherwise indicated. Interconnect ground rods with grounding electrode conductors. Use exothermic welds and as otherwise indicated. Make connections without exposing steel or damaging copper coating. Driven ground rods shall be used for all electrode locations. In the event that the ground rods can not be driven (i.e., due to rock), inform the Architect's Representative immediately. At the recommendation of the Architect's Representative, ground plates, shall be substituted in place of the ground rods.
- B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

- C. Metal Domestic Water Service Pipe: Where possible, provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- D. If system requires multiple grounding electrodes connect them in series, not parallel.

3.3 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- C. Torque: Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in applicable UL Standards.

3.4 GROUNDING TESTING

- A. Refer to Section 269510 of this specifications for requirements.

3.5 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 260560

SECTION 260575 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Electrical Specification on Drawing OE001 and specific notes on drawings provided by TPWD should take priority over this set of specifications.
- C. These Specifications are intended to supplement TPWD specifications and shall be used only if TPWD do not cover some of the project requirements.

1.2 SUMMARY

- A. This Section includes electrical identification materials and devices required to provide labeling and identification as specified herein and to comply with applicable ANSI and OSHA standards as follows:
 - 1. Raceways and cables
 - 2. Equipment nameplates
 - 3. Underground lines warning tape
 - 4. Circuits over 600 volts
 - 5. Systems identification
 - 6. Circuit identification on boxes
 - 7. Conductors under 600 volts
 - 8. Power circuit identification
 - 9. Conductor identification
 - 10. Warning and Instructional signs.
- B. Color and legends used for identification in existing buildings shall match existing identification methods provided that they comply with current OSHA and ANSI Standards.

1.3 SUBMITTALS

- A. Product: For each electrical identification product indicated, submit product data and procedures used.

1.4 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Brady Company
 - 2. Ideal Industries
 - 3. Panduit Corporation
 - 4. Seaton

1.5 QUALITY ASSURANCE

- A. Comply with applicable OSHA, ANSI, UL and NFPA Standards.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

- A. General: Comply with applicable OSHA and ANSI standards for minimum size of letters for legend and for minimum length of color field for each raceway and cable size. Labels shall be black letters on orange field indicating the voltage and feeder designation.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.
- C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).
- E. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape, not less than 6 inches wide by 4 mils thick (152 mm wide by 0.102 mm thick), with a printed legend indicating type of underground line.
- F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch (0.4-mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
- H. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch (0.05 mm) thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.
- I. Brass or Aluminum Tags: 2 by 2 by 0.05-inch (51 by 51 by 1.3-mm) metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with OSHA Regulations.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes. Nameplates shall be punched or drilled for mechanical fasteners.
- C. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.

- D. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength: 50 lb (22.3 kg) minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: According to color-coding.
- B. Metal Rings: Embossed-brass, with metal hook type mounting strap.
1. Minimum Diameter: 1 inch (26 mm).
 2. Minimum Size Lettering: 3/16 inch (5 mm).
- C. Paint: Formulated for the type of surface and intended use.
1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
 2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
 3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
 4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
 2. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
 3. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
 4. Self-Adhesive Identification Products: Clean surfaces before applying.
 5. Painted Identifications: Install painted identification according to manufacturer's written instructions and as follows:
 - a. Clean surfaces of dust, loose material, and oily films before painting.
 - b. Prime surfaces using type of primer specified for surface.
 - c. Apply one intermediate and one finish coat of enamel.
- B. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm) overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- C. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.
1. Color-code 208/120-V system as follows:

- a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
2. Color-code 240/120-V system as follows:
 - a. Phase A: Black.
 - b. Phase B: red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green
3. Factory applied color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch (25-mm) wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
- D. Apply warning, caution, and instruction signs where required by code on equipment as follows:
 1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- E. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment. Unless otherwise indicated, provide a single line of text with 1/2-inch (13-mm) high lettering on 1-1/2-inch (38-mm) high label; where two lines of text are required, use labels 2 inches (50 mm) high. Use white lettering on black field for normal power systems and white lettering on red field for emergency systems. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
 1. Panelboards, electrical cabinets, and enclosures.
 2. Metering equipment
 3. Load Centers (apply labels so that it is visible only by opening the panel door)
 4. Emergency system boxes and enclosures.
 5. Enclosed circuit breakers.
 6. Motor starters and controllers.
 7. Ground Bars.
 8. Contactors.
 9. Control devices.
- F. Install wood bollards posts or other permanent marking posts next to flush with grade electrical pull boxes to mark the location of these boxes.

END OF SECTION 260575

SECTION 269510 ELECTRICAL CLEANING AND TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Electrical Specification on Drawing OE001 and specific notes on drawings provided by TPWD should take priority over this set of specifications.
- C. These Specifications are intended to supplement TPWD specifications and shall be used only if TPWD do not cover some of the project requirements.

1.2 SUMMARY

- A. The work included under this section of these specifications consists of the furnishing of all labor to thoroughly clean and test all equipment and systems. It will be required of the Testing Agency to prove proper electrical voltage and capacity at each and every outlet and the proper rotation of all motor driven equipment. Coordinate the work with Commissioning Agent.
- B. Each and every circuit shall be tested to assure freedom from grounds and the proper insulation resistance. The installing Contractor shall light and test each lamp and prove and test that energy is available at the load side of each disconnect switch and at final points of connection to all driven equipment.

1.3 SUBMITTALS

- A. Procedures and Forms: For each test specified provide a copy of the test procedures and applicable data sheet or form applicable to the anticipated activities.
- B. Schedule: Provide a preliminary schedule of all anticipated activities related to cleaning, testing, and commissioning of the facility.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. All tests shall be witnessed by TPWD representative, and/or by TxDOT representatives, and/or by Owner designated representative.

1.4 QUALITY ASSURANCE

- A. The tests and inspections shall prove that the electrical equipment is operational within industry and manufacturers' tolerances and that it is installed in accordance with the design drawings and specifications.
- B. The tests and inspections shall be conducted in accordance with the applicable standards of the following organizations or agencies:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. American National Standards Institute (ANSI)

3. Institute of Electrical and Electronic Engineers (IEEE)
4. Insulation Cable Engineers Association (ICEA)
5. InterNational Electrical Testing Association (NETA)
6. National Electrical Manufacturer's Association (NEMA)
7. National Fire Protection Association (NFPA)
8. Occupational Safety and Health Administration (OSHA)
9. Underwriters Laboratories, Inc. (UL)
10. State, Federal and Local Codes or Ordinances

1.5 SAFETY AND PRECAUTIONS

- A. It is recognized that an overwhelming majority of the tests and inspections required by these specifications are potentially hazardous. Inherent in this determination is the prerequisite that individuals performing these tests and inspections be capable of conducting such in a safe manner and with complete knowledge of the hazards involved.
- B. The Contractor shall have a designated safety representative on-site to supervise operations with respect to safety.
- C. Safety practices shall include, but are not limited to, the National Electrical Code (NEC), Occupational Safety and Hazard Act (OSHA), Institute of Electrical and Electronic Engineers (IEEE), National Fire Protection Association (NFPA), all applicable City, County, State, and National codes, specifications, standards and ordinances.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The Contractor shall be required to provide the materials, equipment, labor and technical supervision needed to perform the tests and inspections herein specified.
- B. Upon completion of the tests and inspections called for in these specifications, labels shall be provided in accordance with NETA labeling policy.

2.2 DIVISION OF RESPONSIBILITY

- A. The Contractor shall perform routine insulation resistance, continuity and rotation tests for distribution and utilization equipment prior, and in addition, to the tests specified herein to be performed by the Testing Agency.
- B. The Contractor shall be responsible for implementing final settings and adjustments on protective devices and transformer taps in accordance with design values.
- C. Material and workmanship found defective during the tests shall be reported immediately to the Architect's Representative.
- D. The Contractor shall maintain written records of the tests, and upon completion of the project shall assemble and certify a final test report.

2.3 TEST INSTRUMENT TRACEABILITY

- A. The Contractor shall have a calibration program that maintains applicable test instrumentation within rated accuracy.
- B. The accuracy shall be traceable to the National Bureau of Standards (NBS) in an unbroken chain.
- C. Instruments shall be calibrated in accordance with the following frequency schedule:
 - 1. Field instruments - 6 months maximum.
 - 2. Laboratory instruments - 12 months maximum.
 - 3. Leased specialty equipment - 1 month maximum.
- D. Dated calibration labels shall be visible on test equipment.

2.4 TEST REPORT

- A. The test report shall be documented in writing and signed by the appropriate craftsman such as electricians, fire alarm technicians etc. and shall include the following:
 - 1. Name, address and telephone number of the Contractor.
 - 2. Summary of project.
 - 3. Detailed description of equipment tested.
 - 4. Detailed description of test including copies of appropriate standards and procedures.
 - 5. List of test equipment used in calibration, and calibration date.
 - 6. All test results.
 - 7. Conclusions and recommendations.
 - 8. Appendix, including appropriate test forms, photographs, and computer disks.
- B. The test report shall be bound its contents certified by a Professional Engineer.
- C. Furnish the completed report to the Architect's Representative no later than thirty (30) days after acceptance of the project for beneficial use or final completion.
- D. Furnish the required quantity of test reports in accordance with Division 1 of these Specifications.

PART 3 - EXECUTION

3.1 CLEANING

- A. The Contractor shall thoroughly clean equipment and have construction debris removed and the equipment left clean on the inside and outside.
- B. Each item and component of the equipment shall be protected at all times from damage by other trades by signs, barriers and other means whereby other trades are made fully aware of the importance of protecting this equipment from damage.

- C. After the building is completed and ready for final acceptance, arrange for a complete power outage on the equipment and provide a thorough cleaning. This shall be performed before the final inspection. Each component shall be cleaned, vacuumed, and wiped clean and all dust or other foreign materials removed. Components shall be cleaned of all oxidation. Any portion needing touch-up finishing shall be so finished to equal the specified finish on the product.

3.2 ELECTRICAL IDENTIFICATION

- A. The Contractor shall thoroughly inspect the equipment and project site for compliance with the electrical identification requirements specified in other Division 26 Specification Sections.

3.3 TESTING

- A. Load Centers and Panelboards:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect for physical damage.
 - b. Compare equipment nameplate information with corresponding requirements of the drawings, specifications and report discrepancies.
 - c. Inspect for proper alignment, anchorage and grounding.
 - d. Check tightness of bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper foot-pound levels.
 - e. Inspect doors, panels and sections for paint, dents, scratches, and fit, and for presence of all bolts, nuts and other fasteners used for assembly of equipment.
 - f. Inspect insulators for evidence of physical damage or contaminated surfaces.
 - g. Verify proper barrier and shutter installation and operation.
 - h. Exercise all active components.
- B. Cables - Low Voltage (600 Volts and Less):
 - 1. Visual and Mechanical Inspection:
 - a. Inspect cables for physical damage and for proper connections in accordance with the requirements of the drawings and specifications.
 - b. Cable connections shall be torque tested to manufacturer's recommended values.
 - 2. Electrical Tests:
 - a. Perform insulation resistance tests on each cable with respect to ground and to adjacent cables. Include 500V DC megger test to all wiring #1/OAWG and larger after wiring installed in conduit. Evaluate results by comparison of same length and type of similar cables. Investigate any values below 50 megohms.
- C. Circuit Breakers - (Low Voltage 100A and Larger):
 - 1. Visual and Mechanical Inspection:
 - a. Check each circuit breaker for proper mounting, conductor size and feeder designation.
 - b. Operate circuit breaker to insure smooth operation.
 - c. Inspect case for cracks or other defects.
 - d. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.
 - e. Check charging mechanism and verify correct operation of all auxiliary devices (i.e., under voltage relays, trip units, shunt trips, etc.).
- D. Grounding System:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect ground systems for compliance with requirements of drawings and specifications.

- b. Inspect the service entrance and all separately derived systems for adequate grounding and compliance with the NEC.
- 2. Electrical Tests: refer to electrical Specification on Drawing OE001.
- E. Electrical Specification on Drawing OE001 and specific notes on drawings provided by TPWD should take priority over this set of specifications.
- F. Thermographic Study:
 - 1. Perform a Thermographic study of all electrical connections including: load centers, panelboards, starters, circuit breakers, and local disconnect switches and enclosed circuit breakers installed at the equipment. The study should be performed while the equipment is operating under normal conditions.
 - 2. Provide report indicating the following:
 - a. Problem area (location of "hot spot").
 - b. Temperature rise between "hot spot" and normal or reference area.
 - c. Cause of heat rise.
 - d. Phase unbalance, if present.
 - e. Provide photographs and the thermograms of all equipment scanned and provide explanation of the deficient area as seen on the imaging system.
 - 3. Test Parameters:
 - a. Scanning distribution system with ability to detect 1 degree C between subject area and reference at 30 degrees C.
 - b. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - c. Infrared surveys should be performed during periods of maximum possible loading but not less than fifty percent (50%) of rated load of the electrical equipment being inspected.

END OF SECTION 269510

SECTION 31 22 16 - FINE GRADING

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes:
 - 1. Furnish all labor, material, equipment, related services and supervision necessary for or incidental to fine grading all disturbed areas within the limits of work as shown or indicated on the Drawings and/or as specified.
- B. Related Documents
 - 1. Drawings and General provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 2. All other Divisions of the Contract Documents. Refer to each Division's specifications and drawings for all requirements, including but not limited to the following:
 - a. Earthwork – Section 31 20 00.
 - b. Topsoil – Section 32 91 19.16
 - c. Turf and Grasses – Section 32 92 10.
 - d. Plants – Section 32 93 10.

PART 2 - PRODUCTS

2.1 LIMITS OF WORK:

- A. The areas to be fine graded are all those disturbed areas within the limits of work as defined on the construction documents.

2.2 SEQUENCE OF WORK:

- A. Fine grading will not be attempted until all construction involving heavy equipment and vehicles is complete.
- B. After fine grading is accomplished, it shall be the Contractor's responsibility to protect all fine graded areas from vehicular traffic or other disruptive activities. Damages to the fine graded surfaces will be restored to a satisfactory condition as prescribed herein until the job is completed and accepted by the Architect.

2.3 FINE GRADING OPERATIONS:

- A. The following measures will be executed in the accomplishment of fine grading areas to be planted in turfgrass. The Contractor may elect to use additional or supplemental measures to accomplish fine grading.
 - 1. Fine grading will be executed with any or all of the following or other appropriate machinery: lightweight road grader, tractor box blade, discing machinery, weighted spike harrow, and weighted drags. Bull Dozer blades or front end loader buckets are not acceptable devices for fine grading operations.
 - 2. It is anticipated that some areas of earth embankment and high traffic areas may become overcompacted and resistant to proper grading. Such areas will be loosened and pulverized with discing machinery and will then be recompact to normal density before fine grading. The use of a watering truck to moisten dried and hardened areas may be necessary.

2.4 ACCEPTABILITY:

- A. The Architect will determine if fine graded areas are acceptable. Areas deemed unacceptable will be corrected and re-graded until they are acceptable.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which fine grading is to be performed and notify Owner/Architect of conditions detrimental to the proper and timely completion of the work.

3.2 PREPARATION:

- A. Provide adequate protective measures of shoring, bracing, piling, planking and cribbing to protect existing adjacent construction.
 - 1. Protect all reference points, benchmarks and monuments from dislocation or damage.
 - 2. Replace or repair immediately any points damaged, destroyed, or dislocated.
 - 3. Sprinkle and dampen all dusty material from the beginning of work to its completion.
 - 4. Protect and maintain all conduits, drains, inlets, sewers, pipes and wires that are to remain.
 - 5. Provide, erect and maintain all lights, barricades, warning signs and guards as necessary.
- B. The Contractor shall layout all work required and is responsible for all elevations, dimensions and verification of actual conditions. Refer discrepancies to the Architect for interpretation or required modifications.
- C. Remove grass, weeds, trees, shrubbery, roots and other vegetation from the areas to be fine graded. Tree roots of protected trees shall not be disturbed. Contractor shall remove vegetation and organic matter by hand labor in tree root zone areas
- D. Coordinate work with Architect in tree root zone areas.

3.3 PUMPING AND DRAINAGE:

- A. Keep fine graded areas free from water, ice and snow at all times. Prevent water from interfering with progress or quality of the work.

3.4 RECONDITIONING FINISHED GRADE:

- A. Where approved grades are compacted or disturbed by Contractor's subsequent operations or adverse weather, the finished grades shall be scarified and re-graded as specified herein prior to further construction thereon.

3.5 GRADING:

- A. Establish grades by means of grade stakes placed as required. Hold down subgrade to allow depths required for topsoil placement.
- B. Fine grade to the elevations required by the drawings.
- C. Imported topsoil, if required, will be furnished by the Contractor and installed in landscape planting and lawn turf areas as indicated on the landscape plan. Native topsoil will be placed in the areas from which they were salvaged from as per the drawings.

- D. Finish grade to the elevations required by the drawings and for proper drainage. At intermediate points, for which finish grades are not indicated, the finish grade shall be of uniform level of slope between points for which elevations are given. Round any abrupt changes in elevation.
- E. Laser grade athletic fields to be precision graded using laser leveling equipment to achieve a tolerance of 1/10 of an inch.

3.6 ADJUSTMENTS AND CLEANING:

- A. Settlement or washing that occurs in fine graded areas prior to acceptance of work shall be repaired and grades re-established to the required elevations and slopes.
- B. Cleanup all debris caused by the work of this section, keep the site clean and neat at all times.

END OF SECTION

SECTION 32 13 13 - LANDSCAPE CONCRETE PAVING**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Landscape concrete paving.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 03 30 53 - Landscape Cast-in-Place Concrete.
 - 3. Section 07 92 05 - Landscape Joint Sealers.

1.2 REFERENCES

- A. ASTM International (ASTM) D4819 - Standard Specification for Flexible Cellular Materials Made From Polyolefin Plastics.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 3 years experience in work of this Section.
- B. Concrete Mix Design: Free from admixtures and additives not specifically approved by coloring admixture manufacturer.
- C. Mockups:
 - 1. Provide mockups of each concrete paving color and finish, minimum 10 x 10 feet.
 - 2. Show:
 - a. Each paving color.
 - b. Each paving finish.
 - c. Control and expansion joints.
 - 3. Locate where directed.
 - 4. Approved mockups may remain as part of the Work.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Concrete: As specified in Section 03 30 53 except:
 - 1. Formwork:
 - a. Metal forms: Free of deformities, furnished in maximum practical lengths.
 - b. Wood forms: Good grade lumber, sound and free of warp, minimum 2 inch nominal thickness except where extremely short radii of curves require thinner forms.
 - 2. Dowels: Plain round bar dowels, conforming to reinforcing steel requirements.
 - 3. Coloring admixture: Refer to Materials Legend.

2.2 ACCESSORIES

- A. Joint Filler: ASTM D4819, Type II, closed cell polyethylene, non-staining, chemical resistant, ultraviolet stable, non-absorbent, with removable strip providing recess for joint sealer.
- B. Joint Sealer: Specified in Section 07 92 05.

2.3 MIXES

- A. Mix concrete in accordance with Section 03 30 53.

PART 3 EXECUTION

3.1 CONSTRUCTION OF FORMS

- A. Construct formwork in accordance with Section 03 30 53.
- B. Set forms accurately to required grades and alignment.
- C. Brace forms to withstand loads applied during concrete placement.
- D. Install flexible or curved forms of wood or metal for curves with radius of 300 feet or less.
- E. Align straight and curved sections at true tangent points without broken curves.
- F. Form curves uniform and smooth, to radius indicated.
- G. Leave forms in place for minimum 12 hours after completion of finishing operation.
- H. Provide expansion joints where paving abuts other construction, and at maximum 30 feet on center unless otherwise indicated on Drawings.
 - 1. Shape joint filler to concrete cross section and fasten in place.
 - 2. Provide holes for dowel bars maximum 1/8 inch larger than bar diameter.
 - 3. Provide 24 inch long No. 4 reinforcing bars or smooth steel dowels spaced maximum 24 inches on center, centered on expansion joint. Wrap one end of bars or dowels with two layers PVC tape.

3.2 PLACING REINFORCING

- A. Install reinforcement in accordance with Section 03 30 53.
- B. Place reinforcing in middle third of flatwork.
- C. Stop alternate bars of reinforcing steel at control joints.
- D. Provide dowels at maximum 12 inches on center at expansion joints. Wrap one end of dowel in building paper or felt. Stop reinforcement on both sides of joint.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with Section 03 30 53.
- B. Place concrete continuously between predetermined expansion and control joints. Do not interrupt successive placement such that cold joints occur.
- C. Shape curbs and gutters to cross section indicated on Drawings.
- D. Strike off flatwork with screed, then float to uniform surface.
- E. Tool expansion joint edges and other exposed edges to smooth, dense surface with 1/8 inch radius.
- F. Seal expansion joints as specified in Section 07 92 05.

- G. Provide control joints at maximum 10 feet on center unless otherwise indicated on Drawings. Saw joints within 24 hours after concrete placement, to width of single blade x 1/4 of slab depth.
- H. Installation Tolerances: Surfaces true to plane, in longitudinal direction to required grade, within plus or minus 1/4 inch in 10 feet, noncumulative.

3.4 FINISHING

- A. Broom Finish:
 - 1. Steel trowel and light broom finish surfaces with striations running perpendicular to short dimension.
 - 2. Match approved mockup.
- B. Sandblasted Finish:
 - 1. Steel trowel surfaces to uniform surface.
 - 2. After concrete has cured sufficiently to prevent damage, sandblast to uniform light texture.
 - 3. Match approved mockup.

END OF SECTION 32 13 13

SECTION 32 14 40 - STONE PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Stone pavers on mortar setting bed.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 07 92 05 - Landscape Joint Sealers.

1.2 REFERENCES

- A. Tile Council of North America (TCNA) - Handbook for Ceramic, Glass, and Stone Tile Installation.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Samples:
 - a. Stone: 12 x 12 inch samples showing colors and surface textures.
 - b. Grout: ½ x ½ x 3 inch long samples showing available colors.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 2 years experience in work of this Section.
- B. Obtain each stone from a single quarry and from the same area within the quarry.
- C. Mockups:
 - 1. Size: Minimum 4 x 8 feet.
 - 2. Show: Paver sizes, colors and surface textures, maximum color range, and paver pattern.
 - 3. Locate where directed.
 - 4. Approved mockups may remain as part of the Work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store stone off ground; prevent contact with materials that could cause staining or damage.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install pavers at temperatures below 50 degrees F, during precipitation, or when such conditions are forecast within 48 hours after installation.
- B. At end of working day and during rainy weather, cover work exposed to weather with waterproof coverings, securely anchored.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Stone Pavers: Refer to Materials Legend.

2.2 ACCESSORIES

- A. Setting and Grouting Materials: Laticrete International (www.laticrete.com) or approved substitute.
 - 1. Setting mortar: Laticrete 3701 Fortified Mortar.
 - 2. Bond coat: 254 Platinum.
 - 3. Grout: Permacolor Select; color to be selected from manufacturer's full color range.
- B. Joint Sealers and Accessories: Specified in Section 07 92 05.
- C. Cleaner: Type recommended by stone supplier.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pavers in accordance with setting and grouting manufacturer's instructions and TCNA Handbook.
 - 1. Apply bond coat to concrete substrate.
 - 2. Apply setting mortar.
 - 3. Just prior to installing stone, apply bond coat to back of stone.
- B. Support pavers over full bearing surface.
- C. Place pavers in pattern indicated from straight reference line. Maintain 3/8 inch joints between pavers and abutting vertical surfaces and protrusions.
- D. Fill joints with grout. Pack and work into voids. Tool joints to flush profile.
- E. Fill expansion joints with joint sealer as specified in Section 07 92 05.
- F. Allowable Tolerances: Surfaces true to level or indicated slopes with plus or minus 1/4 inch in 10 feet tolerance.

3.2 CLEANING

- A. Protect adjacent and underlying surfaces and plant materials.
- B. Apply cleaner in accordance with manufacturer's instructions.
- C. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

END OF SECTION

SECTION 32 15 00 - AGGREGATE SURFACING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Decomposed granite.
 - 2. Stabilizer.
 - 3. Soil barrier.
 - 4. Herbicide.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.
 - 2. D4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 3. D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Samples:
 - a. 1 pint of each proposed aggregate illustrating color, size, and gradation.
 - b. 12 x 12 inch soil barrier samples.

1.4 QUALITY ASSURANCE

- A. Furnish aggregate from single source throughout Work.
- B. Perform sieve analysis on proposed decomposed granite in accordance with ASTM C136.
- C. Obtain stabilizer manufacturer's approval of decomposed granite aggregate sieve analysis prior to beginning installation.
- D. Mockup:
 - 1. Provide mockups showing aggregate surfacing size and color range, surface texture, and overall workmanship.
 - 2. Size: Minimum 4 x 4 feet.
 - 3. Locate where directed.
 - 4. Approved mockup may remain as part of the Work.

1.5 PROJECT CONDITIONS

- A. Do not place aggregate on soft, muddy, or frozen surfaces.
- B. Do not install aggregate during precipitation or at temperatures below 40 degrees F.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Decomposed Granite:
1. Color: Refer to Materials Legend.
 2. Gradation:

<u>US Sieve No.</u>	<u>Percent Passing by Weight</u>
3/8 inch	100
No. 4	90 to 100
No. 8	75 to 80
No. 16	55 to 65
No. 30	40 to 50
No. 50	25 to 35
No. 100	15 to 20
No. 200	10 to 15

2.2 ACCESSORIES

- A. Stabilizer: Stabilizer by Stabilizer Solutions, Inc. (www.stabilizersolutions.com) or approved substitute.
- B. Soil Barrier: Geosynthetic fabric manufactured specifically for control of weeds under paving or in landscape areas.
- C. Herbicide: Pre-emergent, non-selective type.

2.3 MIXES

- A. Mix stabilizer with decomposed granite aggregate in accordance with manufacturer's instructions.

PART 3 EXECUTION**3.1 PREPARATION**

- A. Correct irregularities in subgrade gradient and elevation by scarifying and reshaping.
- B. Compact subgrade to minimum 85 percent of ASTM D698 standard Proctor maximum dry density at or near optimum moisture content.
- C. Apply herbicide in accordance with manufacturer's instructions. Allow vegetation to die before proceeding.

3.2 INSTALLATION

- A. Place soil barrier over subgrade; install in accordance with manufacturer's instructions.
- B. Spread aggregate over subgrade to minimum compacted thickness indicated. Where overall thickness exceeds 4 inches, place aggregate in two lifts of equal thickness.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Water aggregate to full depth without flooding and runoff.

- E. When aggregate is capable of supporting compaction equipment without damage, roller compact to minimum 95 percent of ASTM D4254 relative density at or near optimum moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- G. Where aggregate surfacing abuts other paving types, align top surface of aggregate to within 1/4 inch of adjacent surfaces after compaction.
- H. Final surface to be firm, stable, free of cracks, and slip-resistant.
- I. After compaction, apply herbicide in accordance with manufacturer's instructions.
- J. Tolerances:
 - 1. Maximum variation from flat surface: 1/2 inch in 10 feet.
 - 2. Maximum variation from thickness: 1/2 inch.
 - 3. Maximum variation from elevation: 1/2 inch.

3.3 FIELD QUALITY CONTROL

- A. Testing and Inspection Services:
 - 1. After compaction of subbase for decomposed granite surfacing perform field in-place density tests per ASTM D6938, one test for each 2500 square feet.
 - 2. Upon completion of decomposed granite surfacing perform field in-place density tests per ASTM D6938, one test for each 2500 square feet.

END OF SECTION 32 15 00

SECTION 32 31 11

SWING GATE OPERATORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electric operators for swing gates.
 - 2. Controls.

1.2 SYSTEM DESCRIPTION

- A. Control System:
 - 1. Entrance:
 - a. Opening initiated by keypad, card reader, or remote control; closing initiated by buried loop vehicle detector.
 - b. Timer to allow gate to remain opened remotely during day and manually closed at night.
 - 2. Exit: Opening and closing initiated by buried loop vehicle detectors.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Illustrate products, installation, and relationship to adjacent construction.
 - 2. Product Data: Manufacturer's descriptive data and product attributes.
- B. Closeout Submittals:
 - 1. Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Firm specializing in work of this Section, with minimum 2 years' experience.

1.5 WARRANTY

- A. Provide manufacturer's 5 year warranty against material and manufacturing defects.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Contract Documents are based on products by Liftmaster. www.liftmaster.com
- B. Substitutions: Refer to Division 01.

2.2 MANUFACTURED UNITS

- A. Swing Gate Operators:
 - 1. Model: CSW24UL.
 - 2. Operation: Gear driven.
 - 3. Meet UL 325, UL 991, and ASTM F2200.
 - 4. Motor: 24 VDC, continuous duty type, sized to gate conditions.
 - 5. Battery backup: Maximum 400 cycles.

6. Monitoring and controls:
 - a. Internet connectivity: MyQ technology with 50 channel FHSS.
 - b. Built-in Wi-Fi with internet gateway.
 - c. Radio receiver: Security+ 2.0 technology.
7. Monitored retro-reflective photo eyes.
8. Monitored small profile wired safety edge.
9. Model EL2000SS telephone entry system.
10. Seven-day gate operator timer.
11. Three-button encrypted DIP remote controls.
12. Internet gateway.

2.3 ACCESSORIES

- A. Linkage: As required by conditions of use.
- B. Concrete: ASTM C94; minimum 3000 psi 28 day strength, 2 to 3 inch slump.
- C. Loop: Teflon coated copper wire in plastic housing.
- D. Loop Groove Filler: Cold-poured rubberized asphalt emulsion.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Set operators on concrete foundation, rigidly connected.
- C. Install linkage between operators and gates.
- D. Saw cut grooves in pavement for buried sensing loops, install loops and lead wires, and fill grooves flush.
- E. Install controls, wiring, conduit, junction boxes, transformers, circuit breakers, and auxiliary components as required. Make connections to power supply and control wiring.

3.2 CLOSEOUT ACTIVITIES

- A. Test and adjust operators for proper operation.
- B. Demonstration: Demonstrate operation and programming of operators to Owner.

END OF SECTION

SECTION 32 33 00 - SITE FURNISHINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Site furnishings.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Indicate locations, dimensions, attachment, and relationship to adjacent construction.
 - 2. Product Data: Manufacturer's descriptive data.
 - 3. Samples: 3 x 3 inch samples showing each finish.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Site Furnishings: Refer to Materials Legend.

2.2 ACCESSORIES

- A. Anchors: Type recommended by furnishing manufacturer for specific application; stainless or corrosion resistant coated steel with vandal resist heads.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install furnishings in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Set plumb, level, and rigid.

END OF SECTION 32 33 00

SECTION 32 91 19.16 - TOPSOIL**PART 1- GENERAL****1.1 SUMMARY:**

- A. Section Includes
 - 1. This section specifies all soil material designated as "Topsoil" on the drawings or in the specifications.
- B. Related Documents
 - 1. Drawings and General provisions of the Contract, including General and Supplementary Conditions and Divisions 1 Specification Sections, apply to this Section.
 - 2. All other Divisions of the Contract Documents. Refer to each Division's Specifications and drawings for all requirements, including but not limited to the following:
 - a. Earth Moving – Section 31 20 00.
 - b. Fine Grading – Section 31 22 16.
 - c. Turf and Grasses – Section 32 92 00.
 - d. Planting – 32 93 00.

1.2 SUBMITTALS:

- A. Samples
 - 1. Provide 1-quart samples for each soil unit making up the topsoil source.
 - 2. Each sample to be a composite of five to seven (5-7) sub-samples taken the full depth of proposed source. On stockpiles, discard upper 6 inches of soil before sampling.
 - 3. Place samples in plastic bags, seal, and place in second paper bag, and label.
- B. Test Reports
 - 1. Prior to starting work, submit 2 certified copies of soil test reports to the Architect for approval.
 - 2. Costs of all tests to be borne by the Contractor.

1.3 QUALITY ASSURANCE:

- B. All soil samples and testing shall comply with procedures specified in:
 - 1. U.S.D.A. Ag. Handbook 60: Diagnosis and Improvement of Saline and Alkali Soils.
 - 2. ASTM D2974
- C. Testing Laboratories
 - 1. Certified facilities normally engaged in agronomic soil testing shall be utilized.
 - 2. Approval by the Owner's representative.
- D. Required Topsoil Tests
 - 1. Chemical analysis indicating:
 - a. Fertility: pH, nitrate nitrogen, cation ammonia nitrogen, phosphate phosphorous, potassium, calcium, magnesium, zinc, iron, and manganese.
 - b. Suitability: total salinity, boron, sodium, potassium, calcium, magnesium, chloride, and sulfate.
 - c. In addition to the above, the topsoil or the Canyon View Day Use area shall be tested for Cation Exchange Capacity (CEC)
 - 2. Physical properties include:
 - a. Organic content
 - 1. The topsoil at the Canyon View Day Use shall not contain sphagnum peat.
 - b. Particle size distribution

PART 2 - PRODUCTS

2.1 TOPSOIL:

- A. Topsoil for the work shall conform to the requirements included in this Section
 - 1. A natural, friable, loamy soil, typical of local topsoil which produces heavy vegetative growth, free from subsoil, weeds, sods, stiff clay, stones larger than ½ inch, toxic substances, debris, or other substances which may be harmful to plant growth.
 - 2. The pH range shall be 6.5 to 7.5.
 - 3. Canyon View day use area is attempting SITES certification; therefore, any imported tops shall match the existing soil composition per SITES requirements. See attached soils report.
- B. Grading Analysis: Two inch sieve, 100 percent passing. Number 4 sieve, 90 percent minimum passing. Number 10 sieve, 80 percent minimum passing.
- C. Sand, silt and clay content:
 - 1. Sand: 20 to 75 percent.
 - 2. Silt: 10 to 60 percent.
 - 3. Clay: 5 to 30 percent.
- D. All topsoil shall be free from all herbicides and insecticides which may adversely affect growth of lawn or planting, or which may contain toxic materials.
- E. Do not deliver in muddy condition.
- F. The Contractor shall not use materials which do not conform to these criteria. At the discretion of the Landscape Architect, such material can either be amended to meet these requirements, or will be removed from the site and replaced with suitable material as specified.

PART 3 – EXECUTION

3.1 Not Used

END OF SECTION

SECTION 32 92 00 - TURF AND GRASSES - ORGANIC**PART 1 – GENERAL****1.1 SUMMARY:**

- A. Section Includes
 - 1. Furnish all labor, material, equipment related services and supervision necessary for or incidental to the installation of the lawns and grasses as shown or indicated on the Drawings and/or as specified.
 - 2. Work Included:
 - a. Soil Preparation and Fine Grading.
 - b. Fertilization.
 - c. Grass Seeding.
 - d. Grass Hydro Mulch.
 - e. Grass Sprigging.
 - f. Grass Sodding.
- B. Related Documents
 - 1. Drawings and General provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 2. All other Divisions of the Contract documents. Refer to each Division 's specifications and drawings for all requirements, including but not limited to the following:
 - a. Fine Grading - Section 31 22 16.
 - b. Planting – Organic - Section 32 93 00
 - c. Planting Maintenance – Organic - Section 32 95 00

1.2 SUBMITTALS:

- A. Delivery Receipts and Invoices: Submit original delivery receipts and invoices for materials used.
- B. Product Data: Submit sample label or specification of fertilizer.
- C. Certificate: Submit State Certificate stating analysis of purity and germination of seed.
- D. Certificate: Submit State Certificate stating variety and purity of grass sprigs.
- E. Certificate: Submit State Certificate stating variety and purity of grass sod.
- F. Application Log: Submit daily log sheets of hydro mulch operations with the following information:
- G. Seed type and amount.
 - 1. Fertilizer analysis and amount.
 - 2. Mulch type and amount.
 - 3. Seeding additive type and amount.
 - 4. Number of loads-amount of water.
 - 5. Area covered.
 - 6. Equipment used-capacity and license number.
 - 7. Signature of nozzle man.
- H. Soil Fertility Test Reports:
 - 1. Testing is to be performed by a laboratory making organic recommendations.
 - 2. Texas Plant and Soil Lab, E. K. Chandler, 5115 W. Monte Cristo Road., Edinburg, TX 78539, (956) 383-0739 (must ask for organic recommendations).
 - 3. Submit analysis, test results and corrective recommendations to Architect.
 - 4. Two tests required of existing soil taken at different locations on the project site as directed by the Architect.

1.3 PROTECTION:

- A. Protect paving surfaces, curbs, utilities, plant materials, and other existing improvements from damage by heavy equipment.
- B. Locate and stake irrigation heads, valve risers and equipment prior to beginning soil preparation work.
- C. Exercise care to prevent the hydromulch slurry from being sprayed inside reservoir basins or drainage ditches and channels which may impede the free flow of rain water runoff or irrigation water.
- D. Clean paving and other surfaces of over-spray and spillage of hydro mulch slurry.
- E. During work and maintenance period, maintain topsoil in place at established grades. Replace topsoil and grass losses due to erosion.
- F. Protect in place work from damage by heavy equipment. Prepare, grade, level and replant damaged areas.

1.4 SUBSTANTIAL COMPLETION & PROJECT CLOSEOUT

- A. A Certificate of Substantial Completion will be issued when the Work performed under the Contract has been reviewed and found, to the Architect's best knowledge, information and belief, to be substantially complete. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use. The date of Substantial Completion of the Project or portion thereof is also the date of commencement of applicable guarantees as specified.
- B. A list of items to be completed or corrected will be attached to the Certificate of Substantial Completion. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract documents.
- C. The Contractor will complete or correct the Work on the list of items within a specific number of days as shown on the Certificate of Substantial Completion.
- D. Upon completion and re-inspection of all corrected items listed, the Architect will recommend to the Owner that the work of this Section is ready for final acceptance.

1.5 QUALITY ASSURANCE:

- A. General: Comply with applicable Federal, State, County and local regulations governing landscape materials and work.
- B. Personnel: Employ only experienced personnel who are familiar with the required work. Provide supervision by a qualified foreman.

1.6 GUARANTEE:

- A. Guarantee lawns and grasses for one year after date of Final Acceptance which is described in paragraph 1.5.D. At the end of this guarantee period, all lawn and grass areas will have achieved coverage of the specified grass at a density of 100% coverage, free of weeds, undesirable grass species, disease and insects. Replace dead materials and materials not in vigorous, thriving condition as soon as weather permits and on notification by the Architect.
- B. Replace lawns and grasses with same kind as originally planted, at no cost to the Owner. Protect irrigation system and other piping, conduit or other work during replacement. Repair damage immediately.

1.7 JOB CONDITIONS

- A. Do not install seed or sod on saturated or frozen soil.
- B. Sod installation shall be subject to suitability of the weather and other conditions affecting sod growth.

1.8 PROGRESS MEETINGS

- A. Contractor shall attend all progress meetings as requested by the Architect/Owner during installation.

1.9 QUANTITY VERIFICATION:

- A. The bidding contractor is responsible for the inclusion of all materials, labor and equipment as outlined in the plans and specification. The plant list is provided to the bidding contractor as a convenience and the quantities are approximate. VERIFICATION OF ALL QUANTITIES IS THE SOLE RESPONSIBILITY OF THE BIDDING CONTRACTOR. Any discrepancies must be reported to the Architect prior to submittal of bid.

PART 2 – PRODUCTS**2.1 GRASS:**

- A. Buffalo Grass Seed: *Buchloe dactyloides* (Buffalo Grass). Seed shall be harvested within one year prior to planting, free of Johnson grass, field bind weed, dodder seed and free of other weed seed to the limits allowable under the Federal Seed Act and applicable seed laws. The seed shall not be a mixture. The seed shall be hulled, extra fancy grade, treated with fungicide and have a germination and purity that will produce, after allowance for Federal Seed Act tolerances, a pure live seed content of not less than 70%, using the formula: $\text{purity \% times (germination \% times plus hard or sound seed \%)}$. Seed shall be labeled in accordance with U.S. Department of Agriculture rules and regulations.
- B. Native Grass Seed: See drawings for selected varieties. Seed shall be harvested within one year prior to planting, free of Johnson grass, field bind weed, dodder seed and free of other weed seed to the limits allowable under the Federal Seed Act and applicable seed laws. The seed shall be hulled, extra fancy grade, treated with fungicide and have a germination and purity that will produce, after allowance for Federal Seed Act tolerances, a pure live seed content of not less than 70%, using the formula: $\text{purity \% times (germination \% times plus hard or sound seed \%)}$. Seed shall be labeled in accordance with U.S. Department of Agriculture rules and regulations.
- C. Wildflower Seed: See drawings for selected varieties. Seed shall be harvested within one year prior to planting, free of Johnson grass, field bind weed, dodder seed and free of other weed seed to the limits allowable under applicable seed laws. The seed shall have a germination and purity that will produce a pure live seed content of not less than 70%, using the formula: $\text{purity \% times (germination \% times plus hard or sound seed \%)}$. Seed shall be labeled in accordance with U.S. Department of Agriculture rules and regulations.
- D. Seed used shall be labeled and furnished in sealed standard containers with signed copies of a statement from the vendor certifying that each container of seed delivered is fully labeled and is in conformance with the requirements of these specifications.
- E. Seed that has become wet, moldy or otherwise damaged in transit or storage will not be accepted.
- F. Buffalo Sod:
 - 1. Sod shall be nursery grown on cultivated agricultural soils. Sod shall have been mowed regularly and carefully and otherwise maintained from planting to harvest.
 - 2. Sod shall be of species indicated.
 - 3. Thickness of Cut: Sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard widths and lengths shall be plus or minus .25 inches on width and plus or minus 5% on length.
 - 4. Broken strips and torn or uneven ends will not be accepted.
 - 5. Strength of Sod Strips: Sod strips shall be strong enough to support their own weight and retain their size and shape if suspended vertically when grasped in the upper 10% of the section.

6. Moisture Content: Sod shall not be harvested or transplanted when moisture content (excessively wet or dry) may adversely affect its survival. Sod shall be stored in a compact group to prevent drying out or freezing.
7. Time Limitations: Sod shall be harvested, delivered and transplanted within a 30 hour period unless a suitable preservation method is approved by the Architect prior to delivery. Sod not transplanted within this period shall be inspected for approval by the Landscape Architect prior to its installation.
8. Thatch: Sod shall be free of thatch.
9. Diseases, Nematodes and Insects: Sod shall be free of diseases, nematodes and soil-borne insects.
10. Weeds: Sod shall be free of objectionable grassy and broadleaf weeds.

2.2 ORGANIC PRODUCTS:

- A. Fertilizer:
 1. Fertilizer shall be a product as approved by the Texas Organic Research Center (TORC), uniform in composition, free flowing, and suitable for application with approved equipment.
 2. Deliver fertilizer to site in fully labeled original containers.
 - a. Fertilizer which has been exposed to high humidity and moisture, has become caked or otherwise damaged, making it unsuitable for use, will not be acceptable.
 3. Application Rates:
 - a. Seeding and Hydro Mulch Initial Application:
 1. Bioform 4-2-4S, Garrett Juice, Turf Pro or approved equal.
 - b. Seeding and Hydro Mulch Second Application:
 1. Garden-Ville 7-2-2, GreenSense 6-2-4, Marshall Grain 7-2-2 or approved equal.
 - c. Sprigging and Sod Initial Application:
 1. Garden-Ville 7-2-2, GreenSense 6-2-4, Marshall Grain 7-2-2 or approved equal.
 - d. Sprigging and Sod Second Application:
 1. Garden-Ville 7-2-2, GreenSense 6-2-4, Marshall Grain 7-2-2 or approved equal.
- B. Vinegar – 20% Solution: GreenSense, Marshall Grain, Garden-Ville or equal.

2.3 EROSION BLANKET:

- A. Curlex Blanket manufactured by American Excelsior Company (817 640-2161) or equal.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Execute grass planting operations across slope and parallel to finished grade contours.

3.2 PRE-PLANT WEED CONTROL:

- A. Irrigated and non-irrigated Grass Areas:
 1. If grassy or broadleaf weeds exist on site at the beginning of work, spray with a vinegar based organic herbicide or physically remove.
 2. Clear and remove these existing weeds by mowing or grubbing off all plant parts at least .25 inches below the surface of the soil over the entire area to be planted.
- B. Irrigated Grass Areas Only:
 1. After irrigation system is operational, apply water for 5 to 10 days as needed to achieve weed germination. Spray with a vinegar-based organic herbicide or physically remove. Repeat as needed.

- C. Maintain lawn and grass areas weed free until final acceptance by Owner utilizing mechanical and chemical treatment.

3.3 SOIL PREPARATION:

- A. Tillage:
 - 1. Tillage shall be accomplished to loosen all areas of compacted soil. When placement of topsoil is specified, till compacted areas prior to placement. Topsoil is required at all seeded areas
 - 2. Till with heavy duty disc, rototiller, or chisel-type breaking plow, chisels set not more than 10 inches apart. Till to a depth of 1 to 3 inches.
 - 3. Initial tillage shall be done in crossing pattern for double coverage then followed by a disc harrow.
- B. Cleaning:
 - 1. Remove debris, building materials, rubbish, weeds, and stones larger than 1 inch in diameter.
 - 2. Use Rock Pick or other machinery to gather surface stones larger than 1 inch in diameter.
- C. Fine Grading:
 - 1. After tillage and cleaning, level, fine grade, and drag with a weighted spike harrow or float drag.
 - 2. Eliminate ruts, depressions, humps and objectionable soil clods.

3.4 FERTILIZING:

- A. The fertilizer types and rates specified herein are applicable unless countermanded by the soil fertility test corrective recommendations, in which case they will be applicable.
 - 1. Buffalo Grass Seeding:
 - a. Initial Application: Apply 45 days after germination at a rate of 15 pounds per 1,000 square feet.
 - b. Second Application: Apply 90 days after germination at a rate of 15 pounds per 1,000 square feet.
 - 2. Second and Third Applications: Apply every 25 days after sprigging or sodding at a rate of 10 pounds per 1,000 square feet.
 - a. Irrigate the area with a minimum of .25 inches of water to properly incorporate the fertilizer into the turf.
 - 3. Buffalo Grass Sodding:
 - a. Initial Application: After the first mowing apply at 10 pounds per 1,000 square feet.
 - b. Irrigate the area with a minimum of .25 inches of water to properly incorporate the fertilizer into the turf.

3.5 PLANTING SEEDED GRASS AREAS:

- A. Apply Buffalo Grass seed evenly at the rate of 1.5 pure live seed pounds per 1,000 square feet using an approved no till drill seeder specifically designed for grass seed installation.
- B. Apply native grass seed at the rate specified using a no-till grass seed drill or a broadcast spreader. Evenly spread seed over the entire area. If using a broadcast spreader, use a rollerpacker or rake to press the seed into the soil. Most seeds should never be buried more than twice their diameter. Do not bury small seeds.
 - 1. **Midway Mix provided by Native American Seed or approved equal**
 - i. **1 pure live seed pounds per 1,000 square feet.**
- C. Apply wildflower seed at the rate specified. Spread half the seed evenly over the whole area. Then cross back in the opposite direction and spread the remaining seed evenly over the entire area. Follow with a rollerpacker or rake to press the seed into the soil.
 - 1. **Apache Palteau Mix provided by Native American Seed or approved equal**
 - i. **1 pure live seed pounds per 2,000 square feet**

- D. Place Erosion Blanket over seeded areas sloped 4:1 and steeper.
- E. Anchor Erosion Blanket with wire staples at edges, through center using trenched in edges per manufacturer recommendation.
- F. Water seeded areas to depth of 4 inches.
 - 1. Timing:
 - a. Drill seed Buffalo Grass from May 1 to August 30.
 - b. Drill seed native grass seed from early spring to late summer when soil temperatures are above 65 degrees.
 - c. Broadcast wildflower seed from August to late November.
- G. When seeding installation of the permanent grass does not fall within the dates specified, Cereal Rye Grass will be seeded at 10 pounds per 1,000 square feet using an approved no till drill seeder specifically designed for grass seed installation. Conversion to the permanent grass variety is part of this scope of work and will take place as and when specified.

3.6 PLANTING SOD

- A. Weather Conditions:
 - 1. Schedule work for periods of favorable weather.
 - 2. Sod placement on days which, in the judgment of the Landscape Architect, are too hot, cold, sunny, dry or windy for optimal installation may be prohibited.
- B. Placement Pattern:
 - 1. The first row shall be laid in a straight line with subsequent rows parallel to the first row and tightly abutting each other.
 - 2. Lateral joints shall be staggered. Care shall be exercised to insure that the sod is neither stretched nor overlapped. Joints must be butted tightly to prevent voids that could permit air to dry out root.
 - 3. Immediately after placing, sod shall be pressed firmly into contact with bed by tamping or rolling to eliminate air pockets. Following tamping, screened topsoil shall be used to fill all cracks and excess soil shall be worked into the sod with rakes or other suitable equipment. Sod shall not be smothered with excess fill soil.
 - 4. On slopes steeper than 3 to 1, sod shall be secured by galvanized pins, wood pegs or other methods approved by the Landscape Architect.
 - 5. Immediately after sodding operations have been completed, the entire surface shall be compacted with a roller or other approved equipment. The completed area after sodding shall be uniformly even, firm and true to finished grade lines.
- C. Watering:
 - 1. Initial Installation: Water must be applied within 2 hours of exposure of the sod to sun or wind. Water newly laid sod until saturation of the entire area is apparent. As a result of initial irrigation, standing water may be present and moderate to heavy run off may occur. Continue to irrigate on a daily basis in shorter durations so the entire area stays thoroughly wet but without standing water. The length of irrigation time and frequency of applications will vary at different locations due to weather conditions and individual site characteristics.
 - 2. After 7 to 10 days: Check for new root growth by lifting corners of sod blocks. If consistent root growth over the entire site is observed, water applications can be reduced to once every other day.
 - 3. After 12 to 14 days: Recheck for additional rooting. If sod blocks are difficult to pull up or additional new roots are present allow the area to dry to the extent that mowing can be performed.
- D. Buffalo Grass:
 - 1. After the initial mowing, continue to irrigate 1 day per week for an additional month.
 - 2. After the first 8 weeks, watering frequency will vary due to factors such as slope, soil texture and climatic conditions. Allow the turf an opportunity to perform in a dry environment. Once the Buffalo Grass is established it can be maintained without irrigation during cool seasons but may require supplemental irrigation during extended periods of drought.

3.7 GRASS CONVERSION:

- A. Conversion of temporary grass to permanent grass:
 - 1. Spray temporary grass with an approved vinegar base organic herbicide or physically remove - 95% kill rate minimum.
 - 2. Scalp dead grass with mowing equipment.
 - 3. Lightly scarify soil surface using a verticut machine or like equipment.
 - 4. Apply permanent grass seed as specified.

3.8 GRADING:

- A. Maintain existing established grades, protect true and even during operations.

3.9 EROSION CONTROL:

- A. During work and maintenance period, maintain topsoil in place at established grades. Replace topsoil and turfgrass losses due to erosion.

3.10 CLEAN-UP:

- A. Remove excess material and debris from site.

3.11 MAINTENANCE:

- A. Until Final Acceptance, maintain lawn and grass areas by watering, mowing, weeding, spraying, cleaning and replacing as necessary to keep the turf and grass in a vigorous, healthy condition.
 - a. Watering: As necessary. Provide temporary above ground sprinklers over un-irrigated areas including temporary water meter if required. Water cost will be paid separately by the Owner or General Contractor unless noted differently on the drawings or bid form.
 - b. Mowing:
 - i. Cereal Rye Grass: Mow only as directed by the Owner and Architect.
 - ii. Buffalo Grass Sod: Mow newly planted grass areas after initial growth reaches 1.5 to 2 inches. Additional mowings may be required as directed by the Owner and Architect.
 - iii. Buffalo Grass Seeding: Mow newly planted grass areas after initial growth reaches 2 to 3 inches. Additional mowings may be required as directed by the Owner and Architect.
 - iv. Native Grasses: Do not mow newly planted areas.
 - c. Weeding: Remove weeds and foreign grass over lawn and grass areas at least once a week. Herbicides may be used only when approved by the Architect.
- B. Follow planting maintenance procedures outlined in Specification Section 02971 – Planting Maintenance - Organic.

END OF SECTION

SECTION 32 93 00 – PLANTING - ORGANIC**PART 1 – GENERAL****1.1 SECTION INCLUDES:**

- A. Furnish all labor, material, equipment, related services and supervision necessary for or incidental to the installation of the trees, plants and groundcovers as shown or indicated on the Drawings and/or as specified.
- B. Work Included:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Groundcovers.
 - 4. Steel Edging.
 - 5. Mulching.
 - 6. Bed Preparation.

1.2 RELATED DOCUMENTS:

- A. Drawings and General provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. All other Divisions of the Contract Documents. Refer to each Division's specifications and drawings for all requirements, including but not limited to the following:
 - 1. Fine Grading - Section 31 22 16.
 - 2. Turf and Grasses – Organic - Section 32 92 00.
 - 3. Planting Irrigation - Section 32 94 00.
 - 4. Planting Maintenance – Organic - Section 32 95 00.

1.3 REFERENCE STANDARDS:

- A. American Standard for Nursery Stock, Edition approved April 14, 2014 by American National Standards Institute, Inc. – plant material.

1.4 SUBMITTALS:

- A. Delivery Receipts and Invoices: Submit original delivery receipts and invoices for materials used.
- B. Product Data: Submit manufacturer's product data sheets for proprietary products in accordance with Section 01 33 00.
- C. Samples:
 - 1. Submit three samples each of small trees and shrubs for the Architect's approval. When approved, tag and maintain as representative samples for finally installed plant materials. Samples may be used to complete installation provided they remain tagged until final acceptance of entire installation.
 - 2. Submit photos of trees and source nursery information to the Architect for review prior to tree tagging. Architect will tag trees at source nursery prior to project delivery.
 - 3. Submit for approval sufficient representative quantities of sandy loam, composted organic material, steel edging, mulch, peat moss and crushed rock. Samples shall be approved by the Architect before use on project.
- D. Soil Fertility Test Reports:
 - 1. Testing is to be performed by a laboratory making organic recommendations. Texas Plant and Soil Lab, E. K. Chandler, 5115 W. Monte Cristo Rd., Edinburg, TX 78539, (956) 383-0739 (must ask for organic recommendations).

2. Two tests required of existing soil taken at different locations on the project site as directed by the Architect.
3. One test required of the specified composted organic material mixed in equal parts with the existing topsoil.
4. Submit analysis, test results and corrective recommendations to Architect.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Deliver packaged materials in containers showing weight, analysis and name of manufacturer.
- B. Protect materials from deterioration during delivery and while stored at the site.

1.6 PROJECT CONDITIONS:

- A. Site Inspection:
 1. It is the bidding contractors responsibility to review all site conditions, as they relate to the proposed project, prior to submission of a bid.. Any issues or concerns will be submitted to the Architect prior to bidding. Submission of a bid will indicate that the bidding contractor has made a site inspection.
- B. Utilities:
 1. Determine locations of underground utilities and perform work in a manner which will avoid possible damage. Do not permit heavy equipment such as trucks to damage utilities. Hand excavate, as required to minimize possibility of damage to underground utilities. Maintain grade stakes until removal is directed.
 2. Coordinate with irrigation work to prevent damage to temporary risers of underground sprinkling system and obstruction of work located in landscape areas.
- C. Protections:
 1. Do not move equipment over existing or newly placed structures without the Architect's approval.
 2. Provide board roading as required to protect paving and soft soil.
 3. Protect other improvements from damage, with protection boards, ramps and protective sheeting as required.
 4. Locate and stake irrigation heads, valve risers and equipment prior to beginning soil preparation work.
 5. During work and maintenance period, maintain topsoil and prepared soil in place at established grades. Replace topsoil, prepared soil and mulch due to erosion.
- D. Delivery and Storage:
 1. Store materials in area covered with protective sheeting.
 2. If balled plants cannot be planted within 24 hours after delivery to site, protect root balls by heeling in with sawdust or other approved material.

1.7 SUBSTANTIAL COMPLETION & PROJECT CLOSEOUT:

- A. A Certificate of Substantial Completion will be issued when the Work performed under the Contract has been reviewed and found, to the Architect's best knowledge, information and belief, to be substantially complete. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use. The date of Substantial Completion of the Project or portion thereof is also the date of commencement of applicable guarantees as specified.
- B. A list of items to be completed or corrected will be attached to the Certificate of Substantial Completion. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

- C. The Contractor will complete or correct the Work on the list of items within a specific number of days as shown on the Certificate of Substantial Completion.
- D. Upon completion and re-inspection of all corrected items listed, the Architect will recommend to the Owner that the work of this Section is ready for final acceptance.

1.8 QUALITY ASSURANCE:

- A. General: Comply with applicable Federal, state, county and local regulations governing landscape materials and work.
- B. Installer Qualifications: The bidding company will specialize in landscape installation with 5 years documented experience. The contractor will staff the project with a competent superintendent and the necessary assistants as approved by the Architect. The superintendent will not be changed except with the consent of the Architect and Owner. The superintendent must have a minimum 5 years experience with similar projects.
- C. Personnel: Employ only experience personnel who are familiar with the required work. Provide adequate supervision by a qualified foreman.

1.9 GUARANTEE:

- A. Guarantee plants and trees for one year after date of Final Acceptance which is described in paragraph 1.7.D. Replace dead materials and materials not in vigorous, thriving condition as soon as weather permits and on notification by the Architect. Replace plants, including trees, which have partially died thereby damaging shape, size or symmetry.
- B. Replace plants and trees with same kind and sizes as originally planted, at no cost to the Owner. At direction of the Architect, trees may be replaced at start of next year's planting or digging season. In such cases, remove dead trees immediately. Protect irrigation system and other piping, conduit or other work during replacement. Repair damage immediately.

1.10 PROGRESS MEETINGS:

- A. Contractor shall attend all progress meetings as requested by the Architect/Owner during installation.

1.11 QUANTITY VERIFICATION:

- A. The bidding contractor is responsible for the inclusion of all materials, labor, and equipment as outlined in the plans and specification. The plant list is provided to the bidding contractor as a convenience and the quantities are approximate. VERIFICATION OF ALL QUANTITIES IS THE SOLE RESPONSIBILITY OF THE BIDDING CONTRACTOR. Any discrepancies must be reported to the Landscape Architect prior to submittal of bid.
- B. The Contractor is required to install the specified type and quantity of composted organic material purchased from the specified supplier. Soil Building Systems will e-mail the Architect as orders are being placed, for verification that the specified material, quantity and supplier are being used.

PART 2 – PRODUCTS**2.1 PLANTS:**

- A. General: Plants shall be well-formed No. 1 grade or better nursery stock in accordance with requirements of reference standards, subject to the Architect's approval. Listed plant heights are from tops of plant balls to the nominal tops of plants.

- B. Shrubs and Groundcovers: Nursery grown, healthy, vigorous, bushy, well branched, of normal habit of growth for species, free from disease, insects, eggs and larvae. Specified sizes shall be before pruning, and plants shall be measured with their branches in normal position. The Architect prior to installation will approve all plants.
- C. Ornamental and Shade Trees: Healthy, vigorous, full branches, well shaped, trunk diameter and height requirements as specified. Balls shall be firm, neat, slightly tapered and well burlaped. Trees with loose or broken balls at time of planting shall be rejected. Each tree will be approved by the Architect prior to installation. Balls shall be 10 inches in diameter for each 1 inch of caliper. All balled and burlaped trees and shrubs will be dug and stored for a minimum of 60 days prior to planting on this project. All trees shall have excess soil removed from the top of the root ball so the root flare is exposed.
- D. Caliper: For trees less than 4 inches is measured 6 inches above top of root ball. Trees 4 inches and above are measured 12 inches above top of root ball.
- E. Trees connected to stakes at the nursery are not acceptable and will be rejected.

2.2 SOIL PREPARATION MATERIALS:

- A. Sandy Loam: Fertile, dark sandy loam free of rubble, stones, lumps, plant roots and reasonably free of weeds. Loam containing nut grass or Dallisgrass shall be rejected.
- B. Organic Fertilizer: Complete fertilizer shall be a product as approved by the Texas Organic Research Center (TORC), uniform in composition, dry and free flowing. Deliver to site in original unopened containers, each bearing manufacturer's guaranteed statement of analysis. Garden-Ville 6-2-2, GreenSense Lawn and Garden Fertilizer 6-2-4, Marshall Grain 7-2-2, Bioform Dry 5-3-4 or approved equal.
- C. Composted Organic Material: Soil Building Systems 'Ph Balanced' Compost or approved equal. It shall be free of treated or used lumber and pine bark with 97% of the material passing through a .5 inch screen and 100% passing through a .75 inch screen.
- D. Dry Molasses: Deliver to site in original unopened containers. GreenSense, Marshall Grain or approved equal.
- E. Texas Greensand: Garden-Ville, Living Earth Technology, GreenSense or approved equal.
- F. Horticultural Cornmeal: Alliance Milling @ (800) 580-5487, GreenSense or approved equal.
- G. Lava Sand: Living Earth Technology, GreenSense or approved equal.

2.3 MISCELLANEOUS MATERIALS:

- A. Crushed Rock: Washed .75 inch to 1.5 inches in diameter.
- B. Tree Staking: Arborguy @ (866) 272-6771.
 - 1. Trees up to 4 inch caliper – Arborguy PRO40HD.
 - 2. Trees up to 6 inch caliper – Arborguy PRO60HD.
- C. Mulch: Shredded native cedar trimmings. Living Earth Technology or approved equal.
- D. Filter Fabric: Mirafi 140N by Celanese Fibers Marketing Co. or equal.
- E. Steel Edging: 1/8 inch x 4 inch, 10 gauge, with 16" tapered steel stakes, 30" O.C. and the painted finish will be dark green powder coat paint electro statically applied and oven baked. The J.D. Russell Company @ 1-800-888-6872 or equal.
- F. 4 inch PVC pipe and cap CUA 55 200.
- G. Water: Provided by Owner.
- H. Technical Concentrate and Plant Enhancer: BioPlex @ 1-800-441-3573

PART 3 – EXECUTION

3.1 EXAMINATION AND PREPARATION:

- A. Examine sub-grade and other related construction for defects that adversely affect Work.

- B. Do not proceed until unsatisfactory conditions have been corrected.
- C. Plant trees and shrubs during normal seasons for such work in the project location and only when weather conditions are suitable.
- D. Plant trees and shrubs after final grades are established and prior to planting of lawns.
- E. Additional soil amendments may be required per soil test results.

3.2 BED PREPARATION:

- A. Scrape away any existing grassy or broadleaf weeds prior to soil tilling.
- B. Layout and stake beds for Architect's approval prior to installation of steel edging and planting.
- C. Excavate existing soil from beds as needed to allow for installation of the specified organic compost and mulch. Excavated materials will be removed from the site as required by the Architect and Owner.
- D. Provide 4 inches of compost in groundcover beds and 6 inches in shrub beds.
- E. Apply Dry Molasses at 7 pounds per 1,000 square feet.
- F. Apply Texas Greensand at 40 pounds per 1,000 square feet.
- G. Add organic fertilizer at 20 pounds per 1,000 square feet.
- H. Add Horticultural Cornmeal at 20 pounds per 1,000 square feet.
- I. Add Lava Sand at 80 pounds per 1,000 square feet.
- J. Till to a depth of 3" into the native soil.
 - 1. The fertilizer types and rates specified herein are applicable unless countermanded by the soil fertilizer test corrective recommendations, in which case they will be applicable.
- K. Grade beds to allow for free flow of surface water to the bed edge and away from buildings. Beds will be mounded 2 inches to 3 inches and tapered at the edges to meet existing grade.

3.3 SHRUB AND GROUNDCOVER SPACING:

- A. Place plants in position on bed areas before containers have been removed. Obtain approval from Architect. Do not remove burlap from shrubs.
- B. Plant where located, setting plants with tops of balls even with tops of beds, and settle soil carefully around each plant ball. Do not compact tamp.
- C. Remove binding materials (such as twine, nylon cord, and wire) from plant trunk.
- D. Water each plant thoroughly with hoses to eliminate air pockets.
- E. Carefully prune plants to remove dead or broken branches and hand-rake bed areas to smooth, uneven surfaces.
- F. Architect reserves the right to interchange or shift locations of plants prior to planting.

3.4 PLANTING:

- A. Ornamental Trees and Large Shrubs:
 - 1. Plant trees and shrubs in pits 3 times greater in diameter than root ball. Backfill with soil removed from the hole. Carefully settle by watering to prevent air pockets.
 - 2. Carefully prune trees to remove dead and broken branches.
 - 3. Place root ball in the center of the hole. Do not handle tree by the trunk when placing in hole. Scarify and roughen sides of holes glazed by mechanical excavation.
 - 4. Make sure the root flare is 2 inches higher than the adjacent soil elevation. Remove excess soil from the top of root balls prior to establishing the proper depth of tree pits. The top of the terminal roots at the outer edge of the root ball should be even with or slightly higher than the adjacent soil elevation. Set root ball on undisturbed soil.

B. Shade Trees:

1. Plant trees in pits 3 times greater in diameter than root ball. Backfill with soil removed from the hole. Carefully settle by watering to prevent air pockets.
2. Carefully prune trees to remove dead and broken branches.
3. Place root ball in the center of the hole. Do not handle tree by the trunk when placing in hole. Scarify and roughen sides of holes glazed by mechanical excavation.
4. Make sure the root flare is 2 inches higher than the adjacent soil elevation. Remove excess soil from the top of root balls prior to establishing the proper depth of tree pits. The top of the terminal roots at the outer edge of the root ball should be even with or slightly higher than the adjacent soil elevation. Set root ball on undisturbed soil.

C. Shrubs Outside Of Beds:

1. Plant shrubs in pits as sized below. Backfill with soil removed from each hole. Excess excavated material will be removed from the site as required by the Landscape Architect and Owner. Set root ball on undisturbed soil.

Container SizePit Size

1 Gallon

10" Diameter x 8" Depth

2 Gallon

14" Diameter x 10" Depth

3 Gallon

16" Diameter x 12" Depth

5 Gallon

20" Diameter x 14" Depth

7 Gallon

24" Diameter x 16" Depth

2. Carefully prune plants to remove dead and broken branches.

3.5 SUMMER DIGGING & TRANSPLANTING:

- A. To minimize transplant shock, plant decline, defoliation or loss to all balled and burlaped plants.
 1. Apply Technical Concentrate and Plant Enhancer to plants 24 to 96 hours prior to digging or transplanting.
 2. Apply with both a foliar and root drench at identical dilutions of 1.0 fl. oz. (low stress conditions) to 3.0 fl. oz. (high stress conditions) per inch of trunk diameter or each 24 inches of plant height. Mix into 5 to 10 gallons of water for each 1 inch of trunk diameter and 24 inches of plant height.
 3. Re-apply in 15 to 30 days or sooner if extreme environmental stress requires. Re-apply at either a rate of 1 to 3 fl. oz. per inch of trunk diameter or 5 to 7 fl. oz. per 5 to 10 gallons of water.

3.6 GUYING TREES:

- A. Guy trees immediately after planting as shown on planting details.
- B. All conifer and juniper tree varieties will be guyed per the tree planting detail.
- C. All container grown and containerized trees will be guyed per the tree planting detail.
- D. All balled and burlaped trees are not required to be guyed but maybe guyed with the Architects approval.
- E. It will be the Landscape Contractor's responsibility to maintain trees in a plumb position through the warranty period whether they are guyed or not.
- F. The landscape contractor will remove and dispose of tree guying materials at the end of the one year guarantee period.

3.7 MULCHING:

- A. After planting has been completed and approved by Architect, cover all bare soil around plants. The depth shall vary depending on the plants being mulched. Large plants will receive a 2 inch depth and plants in 4 inch pots and smaller will receive a 1 inch depth.

At no time will mulch come in contact with the stems of plants. Delay this operation until near final acceptance.

3.8 STEEL EDGING:

- A. Install steel edging. Anchor with steel stakes, 16 inches in length minimum, spaced not more than 30 inches on center and driven at least 1 inch below top of edging. The top of edging will be 1 inch above the adjacent turf elevation.

3.9 CLEANUP:

- A. During work, keep premises neat and orderly including organization of storage areas. Trash, including debris resulting from removing weeds or rocks from planting areas, preparing beds, or planting plants, shall be removed from site daily as work progresses.
- B. Keep sidewalks, streets and courtyard areas clean by sweeping or hosing.

3.10 MAINTENANCE:

- A. Water will be provided by the Owner. Provide necessary hoses and other watering equipment required to complete work.
- B. Until Final Acceptance, maintain plantings and trees by watering, cultivating, weeding, spraying, cleaning and replacing as necessary to keep the landscape in a vigorous, healthy condition and rake bed areas as required.
- C. Follow landscape maintenance procedures outlined in Specification Section 32 95 00 – Planting Maintenance - Organic.

3.11 PLANT SCHEDULE:

- A. Refer to schedule on drawings.

END OF SECTION

SECTION 32 93 96 - TREE SALVAGING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal, stripping, and reuse of designated existing trees.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. A153/A153M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - 3. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Tree Trunks:
 - 1. Removed and salvaged existing Cedar trees with limbs cut off flush with trunk. Leave bark intact.
 - 2. Grind exposed ends smooth.
 - 3. Grind areas where branches were removed smooth and flush.

2.2 ACCESSORIES

- A. Bolts: ASTM A307, hexagonal head type.
- B. Anchors: Galvanized steel, ASTM A653/A653M, G90 coating class.
- C. Fasteners: Hot-dip galvanized steel, ASTM A153/A153M, G90 coating class.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Place tree trunks on anchors set into concrete foundation.
- B. Connect trunks together with bolts, nuts, and washers. Recess bolts flush with adjacent surfaces.

END OF SECTION 32 93 96

SECTION 32 95 00 - PLANTING MAINTENANCE - ORGANIC**PART 1 - GENERAL****1.01 SECTION INCLUDES:**

- A. Landscape Maintenance Contractor shall furnish all labor, equipment and products necessary to maintain newly planted landscaping leaving plants in a vigorous, healthy state through the end of the stated maintenance period. This organic maintenance program shall consist of watering, weeding, fertilizing, disease and insect pest control, pruning, aerating, protective spraying and any other procedures consistent with good organic horticultural practices necessary to insure normal, vigorous and healthy growth of all landscape materials under this contract. Trash and debris will be removed from the project during each regular site visit. Maintenance shall begin following final acceptance of the landscape installation.
- B. The Landscape Maintenance Contractor shall be responsible for the use of all his/her materials, labor and equipment. Injury to plant material caused by such maintenance, labor and equipment shall be corrected and repaired by the Landscape Maintenance Contractor at his/her expense. This includes both reseeding areas damaged by tractor treads when mowing is conducted at an inappropriate time, as determined by the Owner or his/her agent, and replacement of any plants, hardscape, or other amenities on the site when damaged by the Contractor's equipment, materials or agent(s).

1.02 RELATED DOCUMENTS:

- A. Planting Irrigation - Section 32 94 00.
- B. Planting – Organic – Section 32 93 00.
- C. Turf and Grasses – Organic - Section 32 92 00.

1.03 INSURANCE:

- A. Contractor shall provide to the Owner, at his own expense, evidence of adequate Workman's Compensation, General Liability and Property Damage Liability, subject to approval of the Owner.

1.04 CLEAN UP:

- A. All debris, tools, surplus materials, equipment, etc. shall be removed after each regular visit from the maintenance crew. The site shall be left in a neat, acceptable condition such as to meet the approval of the Owner.

1.05 LICENSE REQUIREMENTS:

- A. Irrigation: The Contractor shall possess an irrigator's license issued by the State of Texas and the Texas Board of Irrigators or employ such a licensed irrigator to perform the irrigation system maintenance. The irrigation system shall be maintained under the supervision of the licensed irrigator who shall be on the site at all times during this work. The Owner may require documentation of such license for his records. The Contractor shall verify and adhere to the requirements and codes of any controlling utility authorities.

PART 2 - PRODUCTS**2.01 ORGANIC PRODUCTS**

- A. Organic Fertilizer: Complete fertilizer shall be a product as approved by the Texas Organic Research Center, Inc. (TORC), uniform in composition, dry and free flowing. Deliver to site in original unopened containers, each bearing manufacturer's guaranteed statement of analysis. Garden-Ville 6-2-2, GreenSense Lawn and Garden Fertilizer 6-2-4, Marshall Grain 7-2-2, Bioform Dry 5-3-4 or approved equal. Lawns, shrubs and trees receive the same fertilizer.
- B. Corn Gluten Meal: Deliver to site in original unopened containers. Marshall Grain, Alliance Milling (800) 580-5487 or approved equal.
- C. Horticultural Molasses: Deliver to site in original unopened containers. Marshall Grain (800) 361-1286, Garden-Ville (210) 651-6115 or approved equal.
- D. Texas Greensand: Garden-Ville, Living Earth Technology, GreenSense or approved equal.
- E. Lava Sand: Living Earth Technology, Santa Fe Mining Co. (800) 727-5750 or approved equal.
- F. Garrett Juice: Garden-Ville Garrett Juice, GreenSense Foliar Juice or approved equal.
 - 1. Formula For Garrett Juice Concentrate - Mix 1 ½ cups per one (1) gallon of water:
 - a. One (1) gallon of compost tea or liquid humate.
 - b. One (1) pint liquid seaweed.
 - c. One (1) pint blackstrap molasses.
 - d. One (1) pint apple cider vinegar.
- G. Garlic Pepper-Tea Insect Repellent: Marshall Grain or approved equal.
 - 1. Formula For Garlic Pepper-Tea:
 - a. In a blender with water, liquefy two (2) bulbs of garlic and two (2) cayenne or habanero peppers. Strain away the solids.
 - b. Pour the garlic-pepper juice into a one gallon container. Fill the remaining volume with water to make one gallon of concentrate.
 - c. Shake well before using and add ¼ cup of the concentrate to each gallon of water in the sprayer.
- H. Citrus Oil: GreenSense Citrus Oil, Marshall Grain Orange Oil, Garden-Ville Orange Oil or approved equal.
- I. Vinegar – 10% Solution: GreenSense, Marshall Grain, Garden-Ville or approved equal.
- J. Tree Trunk Goop: GreenSense, Garden-Ville or approved equal.
 - 1. Formula for Tree Trunk Good - Mix the following with water.
 - a. 1/3 Soft rock phosphate or fireplace ashes.
 - b. 1/3 Natural diatomaceous earth.
 - c. 1/3 Manure compost.
- K. Horticultural Oil: Marshall Grain or approved equal.
- L. Natural Diatomaceous Earth: GreenSense, Marshall Grain or approved equal.
- M. Nolo Bait: Marshall Grain or approved equal.
- N. Surround WP: Engelhard Corp. (877) 240-0421.
- O. Potassium Bicarbonate: GreenSense, GardenVille or approved equal.
- P. Consan Triple Action 20: Consan Corp. (800) 926-6726.
- Q. Bon-Neem: Marshall Grain or approved equal.
- R. Beneficial Insects: Marshall Grain or approved equal.

2.02 SOIL FERTILITY TEST:

- A. The Contractor will be required to furnish the Owner with two (2) soil fertility reports including corrective recommendations.
- B. The exact location of each soil sample taken will be provided by the Architect or Owner.

- C. Soil fertility testing will be conducted by a laboratory making organic recommendations. Texas Plant and Soil Lab, E. K. Chandler, 5115 W. Monte Cristo Rd., Edinburg, TX 78539, (956) 383-07399 (must ask for organic recommendations).

2.03 MULCH:

- A. Shredded hardwood mulch (provided by Soil Building Systems or approved equal.) .

2.04 WATER:

- A. Water will be supplied by the Owner.

2.05 PLANT REPLACEMENT:

- A. It will be the responsibility of the Contractor to replace any and all plant material that is dead or damaged due to non-performance of the contracted scope of work, un-supervised personnel or un-supervised subcontractors.

2.06 PEST AND DISEASE CONTROL:

- A. Pesticides and herbicides shall be organic and non-toxic as approved by the Texas Organic Research Center (TORC).
- B. Insects on ornamental plants:
 1. Aphids: Spray orange oil-based product plus the release of ladybeetles. Bon-Neem can also be used.
 2. Armyworms, cankerworms, leaf rollers, tent caterpillars, sod webworms, webworms and other larvae of moths and butterflies: Treat when insects are active between April and September with *Bacillus thuringiensis*. For quick control of heavy infestations spray citrus oil.
 3. Bagworms: Release trichogramma wasps at spring leaf emergence. Once bags have formed, hand removal is the only solution.
 4. Borers: Active borers in trunks can be treated with Tree Trunk Goop or beneficial nematodes. To prevent their return apply the Sick Tree Treatment (Item 3.01.A.8).
 5. Cucumber and Other Destructive Beetles: Treat with Bon-Neem or citrus oil. Apply beneficial nematodes to the soil.
 6. Fire Ants: Treat mounds with citrus oil. Apply beneficial nematodes and horticultural cornmeal.
 7. Galls: Normally not a problem. For heavy infestations, spray Bon-Neem and apply the Sick Tree Treatment (Item 3.01.A.8).
 8. Grasshoppers: Treat in the spring with Nolo Bait. Treat insects that are feeding with Surround WP or other kaolin clay or particle film product.
 9. Lacebugs: Treat at first sign of infestation with horticulture oil, Bon-Neem or citrus oil.
 10. Leaf Minors: Treat with Bon-Neem or garlic-pepper tea when first symptoms appear or on leaves usually in summer months.
 11. Pine Tip Beetle: Release trichogramma wasps in the early spring.
 12. Pine Bark Beetle: Treat with Bon-Neem or citrus oil.
 13. Scale: Treat infestations with horticultural oil or orange oil. Follow the temperature restrictions for use of horticultural oil or orange oil.
 14. Twig Girdlers: Treatment is unnecessary. These interesting insects are only a temporary cosmetic problem.
- C. Insects on turf grass:
 1. Chinch Bugs: Treat with natural diatomaceous earth during dry weather, spray with citrus oil under other weather conditions.
 2. Fire Ants: Treat mound with citrus oil. Apply beneficial nematodes and horticultural

- cornmeal.
 - 3. Grub worms: The microbe stimulating nature of the organic soil amendments and fertilizers and the organic program in general usually control the harmful grubs. For unusual outbreaks apply beneficial nematodes.
 - 4. Mites: Spray Garrett Juice plus garlic-pepper tea. Horticultural oil can be used as a last resort.
 - D. Diseases:
 - 1. Powdery Mildew: Treat when present with Garrett Juice plus potassium bicarbonate. Treat soil with horticultural cornmeal at 20 pounds per 1,000 square feet.
 - 2. Rust: Treat with Garrett Juice plus Remedy or other potassium bicarbonate product.
 - 3. Leaf Spot: Treat when present with Garrett Juice plus potassium bicarbonate. Use at one ounce per gallon or per label instructions.
 - 4. Fungal Leaf Spot: Treat when present with Garrett Juice plus potassium bicarbonate.
- Apply horticultural cornmeal to the soil at 20 pounds per 1,000 square feet.
- 5. Oak Leaf Blister: Treat with Garrett Juice plus a potassium bicarbonate product.
 - 6. Oak Wilt: Spray Garrett Juice plus garlic tea and apply Sick Tree Treatment.
 - 7. All Other Fungal Diseases: Spray Garrett Juice plus potassium bicarbonate product. Apply horticultural cornmeal at 20 pounds per 1,000 square feet.
 - 8. All Other Bacterial Diseases: Spray Garrett Juice plus Consan 20 or hydrogen peroxide.

PART 3 - EXECUTION

3.01 TREE, SHRUB AND GROUNDCOVER MAINTENANCE:

- A. The Scope of Work for plant maintenance includes all possible means required to preserve the plants and vegetative material existing within the site in a healthy and vigorous growing condition to insure their successful establishment. Plant maintenance shall include, as a minimum, the following items.
 - 1. Pruning: All trees and shrubs, within the limits of landscape maintenance, shall be pruned by the Contractor to the satisfaction of the Owner. Pruning shall be done in accordance with accepted pruning practices as set forth by the National Arborist Association in Pruning Standards for Shade Trees (current edition). Dead or damaged limbs on trees and shrubs, including sucker-growth on trunks of trees, are to be removed. Crape Myrtles will be pruned in late winter only to remove dead wood, crossing limbs and ground suckers. Suckers will be removed as needed throughout the year. All pruned materials shall become the property of the Contractor and shall be disposed of in a manner acceptable to the Owner. Unless directed differently in the contract documents, pruning shall be accomplished once during the term of this contract.
 - 2. Insect, Disease, and Animal Control: The Contractor shall inspect the plants and planted areas once each two (2) weeks or as approved by the Owner. The Contractor shall be required to notify the Owner in writing of problems with insects, diseases, or animals as such problems arise. The Contractor also shall recommend corrective measures in writing.
 - 3. The Contractor shall treat the plants and/or the planted areas in accordance with accepted methods of organic horticultural practices.
 - 4. Bed Maintenance: The Contractor shall maintain the beds free of weeds and grass or other material detrimental to the growth of the plants or appearance at the site. Use manual weeding and post emergent organic herbicide (corn gluten meal) applications as required. Cedar mulch shall be maintained to a minimum depth of two (2) inches in all bed areas making sure not to pile the mulch onto the stems of plants.

5. Fertilization: Shrub and groundcover beds shall be fertilized in February, June and September for a total of Three (3) applications. The first and third applications shall be corn gluten meal at 20 pounds per 1,000 square feet. The June application shall be organic fertilizer at 20 pounds per 1,000 square feet.
6. Re-guying or Re-staking of Trees (Where Approved by Architect): Any damaged or destroyed stakes or guys shall be replaced by the Contractor. This shall include any adjustment to the staking or guying to prevent girdling of plants. Adjustment will be made to tighten Arboguy ties as required.
7. Seasonal Color: All seasonal color beds will be changed three (3) times per year, Spring, Summer and Fall. Each seasonal color change will include the following:
 - a. Four inch pots spaced triangularly at 9 inches on center - plant species to be selected by the Owner or Owner's Representative.
 - b. Organic fertilizer applied at 20 pounds per 1,000 square feet.
 - c. Horticultural cornmeal applied at 20 pounds per 1,000 square feet.
 - d. Two inches of compost tilled into the existing soil.
8. Tree Mulching and Tree Care:
 - a. Maintain a 2" layer of native hardwood mulch over all tree root balls in turf areas. Add new mulch as required. Taper the mulch to a very thin layer at the tree trunk. Do not allow mulch to be piled up on trunks.
 - b. For any trees that are in less than perfect health, drench the planting hole area with Garrett Juice combined with Turf Pro. If problems persist, apply the entire Sick Tree Treatment to at least 10 feet beyond the original tree hole.
9. Sick Tree Treatment:
 - a. Remove excess soil from above root ball.
 - b. Aerate the root zone heavily. Start between the drip line and the trunk and go far out beyond the drip line. A 7 to 12 inch depth of the aeration holes is ideal but any depth is beneficial. An alternative is to spray the root zone with a living organism product or an approved bio-stimulant.
 - c. Apply Texas Greensand at 40 to 80 pounds per 1,000 square feet, lava sand at 40 to 80 pounds per 1,000 square feet, horticultural cornmeal at 10 to 20 pounds per 1,000 square feet and dry sugar or dry molasses at 5 pounds per 1,000 square feet.
 - d. Apply a 1" layer of compost followed by a 3 to 5 inch layer of shredded native cedar tree trimmings.
 - f. Spray foliage and soil monthly or more often if possible with Garrett Juice.

3.02 TURF AND GRASS MAINTENANCE:

- A. Buffalo Grass:
 1. Mowing and Trimming: Mow one (1) time in March to remove dead foliage. Leave in it's natural condition the rest of the year.
 2. Fertilization: Buffalo Grass shall be fertilized in March for a total of one (1) application. Apply 10 pounds of organic fertilizer per 1,000 square feet.
 3. Insects, Disease and Animal Control: The Contractor shall be required to notify the Owner in writing of problems with insects, diseases, or animals as such problems arise. The Contractor also shall recommend organic corrective measures in writing.

3.03 IRRIGATION SYSTEM OPERATION AND MAINTENANCE:

- A. The scope of work for the operation and maintenance of the permanent irrigation system shall consist of the monitoring, adjustment, repair and proper operation of the existing irrigation system as required to ensure adequate moisture to the plant material existing on the project. The existing condition of the system and any known deficiencies will be

corrected by the Contractor upon approval by the Owner. The Contractor shall insure that all irrigation zones, rain sensors and freeze sensors are operating correctly. Include seasonal draining and winterizing of irrigation system when required.

- B. System repairs will include monitoring of the system on a year round bi-weekly basis and reporting of all damaged or trouble areas to the Owner. The Contractors personnel shall repair any damage that may have occurred during the mowing cycle and set automatic systems to correct time requirements. Any damage not the fault of the Landscape Maintenance Contractor shall be assessed and brought to the attention of the Owner with an estimate of the subsequent costs to make the repairs. In the event the irrigation system fails due to the Contractor's actions or neglect, the Contractor shall furnish plant irrigation by a method and quantity approved by the Owner.

END OF SECTION